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Standards Support and Environmental Impact Statement. Volume 2: Promulgated Standards of Performance for Grain Elevator Industry

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Standards Support and Environmental Impact Statement

Volume 2: Promulgated Standards of Performance for Grain Elevator Industry

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16. ABSTRACT

STANDARDS OF PERFORMANCE FOR THE CONTROL OF PARTICULATE MATTER EMISSIONS FROM NEW, MODIFIED, AND RECONSTRUCTED GRAIN TERMINAL ELEVATORS AND CERTAIN STORAGE ELEVATORS AT GRAIN PROCESSING PLANTS ARE BEING PROMULGATED UNDER THE AUTHORITY OF SECTION 111 OF THE CLEAN AIR ACT. GRAIN ELEVATORS ARE A SIGNIFICANT SOURCE OF PARTICULATE MATTER EMISSIONS. STUDIES INDICATE THAT, AS A GENERAL CLASS, PARTICULATE MATTER CAUSES ADVERSE HEALTH AND WELFARE EFFECTS. THE PROMULGATED STANDARDS WILL REDUCE UNCONTROLLED PARTICULATE MATTER EMISSIONS BY MORE THAN 99 PERCENT AND WILL REDUCE PARTICULATE MATTER EMISSIONS BY 70 to 90 PERCENT COMPARED TO EMISSION LIMITS CONTAINED IN TYPICAL STATE OR LOCAL AIR POLLUTION REGULATIONS. AN ANALYSIS OF THE SIGNIFICANT CHANGES IN THE ENVIRONMENTAL AND ECONOMIC EFFECTS ASSOCIATED WITH THE PROMULGATED STANDARDS IS INCLUDED IN THIS DOCUMENT.

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EMISSION STANDARDS AND ENGINEERING DIVISION

U. S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF AIR AND WASTE MANAGEMENT
OFFICE OF AIR QUALITY PLANNING AND STANDARDS
RESEARCH TRIANGLE PARK, NORTH CAROLINA 27711

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Prepared by

Don R. Goodwin

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Date

Don R. Goodwin, Director
Emission Standards and Engineering Division
Environmental Protection Agency
Research Triangle Park, North Carolina 27711

Approved by

David G. Hawkins

5/2 '78

Date

David G. Hawkins
Assistant Administrator
Office of Air and Waste Management
Environmental Protection Agency
401 M Street, S. W.
Washington, D. C. 20460

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1. SUMMARY

1.1 BACKGROUND

On January 13, 1977, standards of performance were proposed for the grain elevator industry (42 FR 2842) under the authority of section 111 of the Clean Air Act. Public comments were requested on the proposal in the FEDERAL REGISTER publication. One thousand eight hundred and seventeen comments were received from grain elevator operators, vendors of equipment, Congressmen, State and local air pollution control agencies, other Federal agencies, and individual U. S. citizens. Many of these comments reflected a general misunderstanding of the proposed standards and were very general in nature. A number of comments, however, contained a significant amount of useful data and information. Due to the time required to review these comments, the standards were suspended on June 24, 1977. This action was necessary to avoid creating legal uncertainties for those grain elevator operators who might wish to undertake various expansions or modification projects before promulgation of final standards.

On August 7, 1977, Congress amended the Clean Air Act. These amendments contained a provision specifically exempting country grain elevators with less than 2.5 million bushels of grain storage capacity from standards of performance developed under section 111 of the Act.

Following review of the public comments, a draft of the final standards was developed consistent with the adopted amendments to the

Clean Air Act. A report responding to the major issues raised in the public comments and containing the draft final standards was mailed on August 15, 1977, to each individual, agriculture association, equipment vendor, State and local government, and member of Congress who submitted comments. Comments were requested on the draft final standards by October 15, 1977. One hundred and one comments were received, and the final standards reflect a thorough evaluation of these comments.

1.2 SUMMARY OF CHANGES SINCE PROPOSAL

1.2.1 Applicability of the Standards

The proposed standards would have applied to all new, modified, or reconstructed farm, country, and terminal grain elevators with a receiving leg capacity of more than 10,000 bushels per hour and all new, modified, or reconstructed grain storage elevators at wheat flour mills, wet corn mills, dry corn mills (human consumption), rice mills, or soybean oil extraction plants. The promulgated standards apply only to new, modified, or reconstructed grain elevators with a permanent grain storage capacity of more than 2.5 million bushels and new, modified, or reconstructed grain storage elevators at wheat flour mills, wet corn mills, dry corn mills (human consumption), rice mills, or soybean oil extraction plants with a permanent grain storage capacity of more than 1 million bushels.

1.2.2 Emission Limits

As a result of information submitted during the public comment periods, several changes have been made in the emission limits included in the standards. The visible emission limits for truck unloading stations and railcar loading and unloading stations have been increased from 0 percent opacity to 5 percent opacity. The visible emission limit for barge and ship loading has been increased from 10 percent opacity

during normal loading and 15 percent opacity during "topping off" loading, to 20 percent opacity during all loading operations. The maximum allowable hole size for perforated plates in column dryers has been increased from 0.084 inch diameter to 0.094 inch diameter.

1.2.3 Modifications

Section 60.12 of the general provisions has been clarified to ensure that only capital expenditures which are spent directly on an affected facility are used to determine whether the annual asset guideline repair allowance percentage is exceeded, and the annual asset guideline repair allowance percentage has been defined to be 6.5 percent. Four types of alterations at grain elevators have been exempted from consideration as modifications. Table 1 summarizes the changes to the regulation between proposal and promulgation.

1.3 SUMMARY OF THE ENVIRONMENTAL IMPACTS

1.3.1 Alternatives to the Promulgated Action

The alternative emission control systems which were considered in selecting the basis for the promulgated standards are discussed in chapter 4 of Volume I of the Standards Support and Environmental Impact Statement (SSEIS). These alternatives are based upon combinations of various emission control techniques for reducing fugitive and process emissions of particulate matter from grain elevators. An analysis of the alternative of taking no action or postponing action, is outlined in chapter 7 of Volume I of the SSEIS. A number of the emission limits included in the proposed standards have been increased. With the exception of railcar unloading, however, these changes do not reflect a change in the emission control systems upon which these limits are

based but a reevaluation of the ability of these emission control systems to reduce emissions. The basis for the emission limits for railcar unloading has been changed from a shed with doors at each end to a shed with open ends. This change will increase particulate emissions to the atmosphere. The increase, however, is judged to be small and does not significantly affect the analysis of the alternatives included in Volume I of the SSEIS.

1.3.2 Environmental Impact of the Promulgated Action

Primary Impact

Several changes to the standards affect the primary impact of reduction in emissions of particulate matter from grain elevators. The rationale for these changes is given in chapter 2 of this document. The standards now apply only to large grain elevators. In addition, the basis for the standards for railcar unloading has been changed and the plate perforation hole diameter for column dryers has been increased. These changes will result in more emissions of particulate matter to the atmosphere and are primarily due to the change in applicability of the standard which was mandated by the August, 1977 amendments to the Clean Air Act. It was estimated that the proposed standards would have resulted in reducing particulate matter emissions by approximately 23,000 tons within a 5 year period, it is now estimated that the promulgated standards will reduce particulate matter emissions by 12,000 tons within a 5 year period.

Table 1-2 of Volume 1 of the SSEIS presents a summary of the environmental impacts associated with implementation of the standards. This matrix will not significantly change as a result of these revisions to the standards.

Secondary Impact

Table 7-1 of Volume 1 of the SSEIS presents a summary of the secondary enviromental impacts attributable to the alternative control systems. These secondary impacts remain unchanged for the promulgated standards of performance.

1.4 CHANGES IN ECONOMIC IMPACTS

In accordance with Executive Orders 11821 and 11949 and OMB Circular A-107, the economic and inflationary impacts of each of the alternative emission control systems were carefully evaluated. This analysis is contained in chapter 6 of Volume 1 of the SSEIS. Since the changes made to the proposed standards do not significantly affect the level of emission control required for a large grain elevator, the economic impact of the promulgated standards is essentially the same as that outlined for the proposed standards for individual elevators. Since the scope of the promulgated standards has been narrowed, however, the estimated national economic impact of the standards has been reduced as discussed in chapter 2 of this document.

2. SUMMARY OF PUBLIC COMMENTS

Approximately 1800 comment letters were received on the proposed standards of performance for grain elevators. Many of these comments were the result of misinterpretation of the standards. A number of comments, however, included a significant amount of data and information. These comments were evaluated and draft final standards developed. A report responding to the major issues raised in the public comments and containing a copy of the draft final standards was sent to all individuals and organizations who had expressed an interest in these standards. A 60 day period was allowed for further comment on the draft final standards and about 100 additional comment letters were received.

The major public comments on the proposed and draft final standards have been combined into the following areas for discussion:

(1) Need for standards.

(2) Emission control technology.

(3) Stringency of the standards.

(4) Opacity.

(5) Economic and energy impacts.

(6) Modifications.

(7) Performance tests.

(8) Safety.

2.1 NEED FOR STANDARDS

Numerous commenters questioned whether grain elevators should be regulated since the industry is a small contributor to nationwide emissions of particulate matter and grain dust is not hazardous or toxic.

The standards were proposed under section 111 of the Clean Air Act. This section of the Act requires that EPA establish standards of performance for new stationary sources which contribute to air pollution. Existing sources are not affected unless they are reconstructed or modified in such a way as to increase emissions. The overriding purpose of standards of performance is to prevent new air pollution problems from developing by requiring maximum feasible control of emissions from new, modified, or reconstructed sources at the time of their construction. This is helpful in attaining and maintaining the National Ambient Air Quality Standard (NAAQS) for particulate mater.

The Report of the Committee on Public Works of the United States Senate in September, 1970 (Senate Report No. 91-1196), listed grain elevators as a source for which standards of performance should be developed. In addition, a study of 200 industrial categories of sources which were evaluated to develop a long-range plan for setting standards of performance for particulate matter ranked grain elevators relatively high. The categories were ranked in order of priority based on potential decrease in emissions. Various grain handling operations ranked as follows: grain processing-4; grain transfer-6; grain cleaning and screening-8; and grain drying-33. Therefore, grain elevators are a significant source of particulate matter emissions and standards of performance have been developed for this source category.

Many commenters felt, however, that it was unreasonable to require country and farm elevators to comply with the proposed standards because of their remote location and small amount of emissions. This sentiment was reflected in the 1977 amendments to the Clean Air Act which exempted country elevators with a grain storage capacity of less than 2.5 million

bushels from standards of performance. Consequently, the scope of the proposed standards has been narrowed and the promulgated standards apply only to new, modified, or reconstructed facilities within grain elevators with a permanent storage capacity in excess of 2.5 million bushels.

A number of commenters also felt small flour mills should not be covered by standards of performance because they are also small sources of particulate matter emissions and handle less grain than some country elevators which were exempted from standards of performance by the 1977 amendments to the Clean Air Act. These processors are considered to be relatively small sources of particulate matter emissions that are best regulated by State and local regulations. Consequently, grain storage elevators at wheat flour mills, wet corn mills, dry corn mills (human consumption), rice mills, and soybean oil extraction plants with a storage capacity of less than 35,200 m^3 (ca. 1 million U. S. bushels) of grain are exempt from the promulgated standards.

With regard to the hazardous nature or toxicity of grain dust, the promulgated standards should not be interpreted to imply that grain dust is considered hazardous or toxic, but merely that the grain elevator industry is considered a significant source of particulate matter emissions. Studies indicate that, as a general class, particulate matter causes adverse health and welfare effects. In addition, some studies indicate that dust from grain elevators causes adverse health effects to elevator workers and that grain dust emissions are a factor contributing to an increased incidence of asthma attacks in the general population living in the vicinity of grain elevators.

2.2 EMISSION CONTROL TECHNOLOGY

A number of commenters were concerned with the control technology used to control emissions from railcar unloading stations and grain dryers.

A number of commenters believed it was unreasonable to base the standards on a four-sided shed for railcar unloading stations at grain elevators which use unit trains. The data supporting the proposed standards were based on observations of visible emissions at a grain elevator which used a four-sided shed to unload railcars. This grain elevator, however, did not use unit trains. Based on information included in a number of comments, the lower rail rate for grain shipped by unit trains places a limit on the amount of time a grain elevator can hold the unit train. The additional time required to uncouple and to recouple each car individually could cause a grain elevator subject to the proposed standards to exceed this time limit and thus lose the cost benefit gained by the use of unit trains. In light of this fact, the proposed visible emission limit based on the use of a four-sided shed for railcar unloading is unreasonable. The promulgated standards, therefore, are based upon the use of a two-sided shed for railcar unloading stations. This change in the control technology for railcar unloading stations resulted in a change to the opacity standard which is discussed in a subsequent section in this chapter.

A number of comments were received concerning the specification of the maximum hole size in the perforated plates used in column dryers. The proposed standards would have permitted holes no larger than 2.1 mm (0.084 inch) in diameter for the dryer to automatically be in compliance. A few comments contained visible emission data taken by certified opacity observers which indicated that column dryers with perforated plates

containing holes of 2.4 mm (0.094 inch) diameter can meet a 0 percent opacity emission limit. Other comments indicated that sorghum cannot be dried in column dryers with a hole size smaller than 2.4 mm (0.094 inch) diameter without plugging problems. In light of these data and information, the specification of 2.1 mm diameter holes is considered unreasonable and the promulgated standards permit perforated plates with a maximum hole size of 2.4 mm diameter.

2.3 STRINGENCY OF THE STANDARDS

Many commenters questioned whether the standards for various affected facilities could be achieved even if the best system of emission reduction were installed, maintained, and properly operated. These commenters pointed out that a number of variables can affect the opacity of visible emissions during unloading, handling, and loading of grain and they questioned whether enough opacity observations had been taken to assure that the standards could be attained under all operating conditions. The variables mentioned most frequently were wind speed, type of grain, dustiness of grain, and moisture content of grain.

It is true that wind speed could have some effect on the opacity of visible emissions, particularly when sheds have only two sides. A well-designed capture system should be able to compensate for this effect to a certain extent, although some dust may escape if wind speed is too high. Compliance with standards of performance, however, is determined only under conditions representative of normal operation, and judgment by State and Federal enforcement personnel will take wind conditions into account in enforcing the standards.

It is also true that the type of grain, dustiness of grain, and moisture content of grain affect the amount of particulate matter

emissions generated during unloading, handling, and loading of grain. A well-designed capture system, however, should be designed to capture this dust under adverse conditions and should, therefore, be able to compensate for these variables.

In developing the data base for the proposed standards, over 60 plant visits were made to grain terminal and storage elevators. Various grain unloading, handling, and loading operations were inspected under a wide variety of conditions. Consequently, the standards were not based on conjecture or surmise, but on observations of visible emissions by certified opacity observers at well-controlled existing grain elevators operating under routine conditions. Not all grain elevators were visited, however, and not all operations within grain elevators were inspected under all conditions. Thus, while the proposed standards were based upon a sufficiently broad data base to allow extrapolation of the data, particular attention was paid to those comments which included visible emission data taken by certified observers from operations at grain elevators which were using the same emission control systems the proposed standards were based upon. Evaluation of these data indicated that the visible emission limit for truck unloading station and railcar loading stations should be 5 percent opacity instead of 0 percent opacity which was proposed. The promulgated standards, therefore, limit visible emissions from these facilities to 5 percent opacity.

As discussed earlier, the emission control technology selected as the basis for the visible emission standard for railcar unloading has been changed from a four-sided shed to a two-sided shed. Visible emission data included with the comments indicate that emissions from such a system will not exceed 5 percent opacity. Consequently, the

promulgated standards limit visible emissions from railcar stations to 5 percent opacity.

A number of commenters also indicated that the opacity limit included in the proposed standards for barge loading was too stringent. One commenter indicated that the elevator operator had no control over when the "topping off" operation commenced because the ship captain and the stevedores decided when to start "topping off." Several State agencies commented that the standards should be at least 20 percent opacity. Based on these comments, the standards for barge and ship loading operations have been increased to 20 percent opacity during all loading operations. The comments indicate that this standard will still require use of the same emission control technology.

Data included with the comments confirm that a visible emission limit of 0 percent opacity is appropriate for grain handling equipment, grain dryers, and emission control equipment. Consequently, the visible emission limits for these affected facilities have not been changed.

2.4 OPACITY

Many commenters misunderstood the concept of opacity and how it is used to measure visible emissions. Other commenters stated that opacity measurements were not accurate below 10 to 15 percent opacity and a standard below these levels was unenforceable.

Opacity is a measure of the degree to which particulate matter or other visible emissions reduce the transmission of light and obscure the view of an object in the background. Opacity is expressed on a scale of 0 to 100 percent with a totally opaque plume assigned a value of 100 percent opacity. The concept of opacity has been used in the field of air pollution control since the turn of the century. The concept

has been upheld in courts throughout the country as a reasonable and effective means of measuring visible emissions.

Opacity for purpose of determining compliance with the standard is not determined with instruments but is determined by a qualified observer following a specific procedure. Studies have demonstrated that certified observers can accurately determine the opacity of visible emissions. To become certified, an individual must be trained and must pass an examination demonstrating his ability to accurately assign opacity levels to visible emissions. To remain certified, this training must be repeated every six months.

In accordance with Method 9, the procedure followed in making opacity determinations requires that an observer be located in a position where he has a clear view of the emission source with the sun at his back. Instantaneous opacity observations are recorded every 15 seconds for 6 minutes (24 observations). These observations are recorded in 5 percent increments (i.e., 0, 5, 10, etc.). The arithmetic average of the 24 observations, rounded off to the nearest whole number (i.e., 0.4 would be rounded off to 0), is the value of the opacity used for determining compliance with visible emission standards. Consequently, a 0 percent opacity standard does not necessarily mean there are no visible emissions. It means either that visible emissions during a 6 minute period are not sufficient to cause a certified observer to record them as 5 percent opacity, or that the average of the twenty-four 15-second observations is calculated to be less than 0.5 percent. Consequently, although emissions released into the atmosphere from an emission source may be visible to a certified observer, the source may still be found in compliance with a 0 percent opacity standard.

Similarly, a 5 percent opacity standard permits visible emissions to exceed 5 percent opacity occasionally. If, for example, a certified observer recorded the following twenty-four 15-second observations over a 6 minute period: 7 observations at 0 percent opacity; 11 observations at 5 percent opacity; 3 observations at 10 percent opacity; and 3 observations at 15 percent opacity, the average opacity would be calculated as 5.4 percent. This value would be rounded off to 5 percent opacity and the source would be in compliance with a 5 percent opacity standard.

None of the standards are based on a single six-minute reading of opacity. Each of the standards are based on the highest opacity readings recorded over a period of time, such as two or four hours, at a number of grain elevators. In addition, opacity standards are never enforced on the basis of a single six-minute reading. A number of opacity readings are made before an enforcement action is initiated.

A number of commenters also felt the opacity standards were too stringent in light of the maximum absolute error of 7.5 percent opacity associated with a single opacity observation. The methodology used to develop and enforce opacity standards, however, takes into account this observer error. As discussed above, opacity standards are based on observations recorded by certified observers at well-controlled existing facilities operating under normal conditions. When feasible, such observations are made under conditions which yield the highest opacity readings such as the use of a highly contrasting background. These readings then serve as the basis for establishing the standards. By relying on the highest observations, the standards inherently reflect the highest positive error introduced by the observers.

Observer error is also taken into account in enforcement of visible emission standards. A number of observations are normally made before an enforcement action is initiated. Statistically, as the number of observations increases, the error associated with these observations taken as a group decreases. Thus, while the absolute positive error associated with a single opacity observation may be 7.5 percent, the error associated with a number of opacity observations, taken to form the basis for an enforcement action, may be considerably less than 7.5 percent.

2.5 ECONOMIC AND ENERGY IMPACTS

2.5.1 Economic Impact

Several comments indicated that the estimated economic impact of the proposed standards was too low. Some commenters questioned the ventilation flow rate volumes used in developing these estimates. The air evacuation flow rates and equipment costs used in estimating the costs associated with the standards, however, were based on information obtained from grain elevator operators during visits to facilities which were being operated with visible emissions meeting the proposed standards. These air evacuation flow rates and equipment costs were also checked against equipment vendor estimates and found to be in reasonable agreement. These ventilation flow rates, therefore, are compatible with the opacity standards. Thus, the unit cost estimates developed for the proposed standards are considered reasonably accurate.

Many commenters felt that the total cost required to reduce emissions to the levels necessary to comply with the opacity standards should be assigned to the standards. The relevant costs, however, are those incremental costs required to comply with these standards above the costs required to comply with existing State or local air pollution regulations.

While it is true that some States have no regulations, other States have regulations as stringent as the promulgated standards. Consequently, an estimate of the costs required to comply with the typical or average State regulation, which lies between these extremes, is subtracted from the total cost of complying with the standards to identify the cost impact directly associated with these standards.

Most State and local regulations, for example, require aspiration of truck dump pit grates and installation of cyclones to remove particulate matter from the aspirated air before release to the atmosphere. The promulgated standards would require the addition of a bi-fold door and the use of a fabric filter baghouse instead of a cyclone. The cost associated with the promulgated standards, therefore, is only the cost of the bi-fold doors and the difference in cost between a fabric filter baghouse and a cyclone.

In conclusion, the unit cost estimates developed for the proposed standards are essentially correct and generally reflect the costs associated with the promulgated standards. As a result, the economic impact of the promulgated standards on an individual grain elevator is considered to be about the same as that of the proposed standards. The maximum additional cost that would be imposed on most grain elevators subject to compliance with the promulgated standards would probably be less than a cent per bushel. The impact of these additional costs imposed on an individual grain elevator would be small.

Based on information contained in comments submitted by the National Grain and Feed Association, approximately 200 grain terminal elevators and grain storage elevators at grain processing plants would be covered by the standards over the next five years. Consequently, over this five

year period the total incremental costs to control emissions at these grain elevators to comply with the promulgated standards, above the costs to control emissions at these elevators to comply with State or local air pollution control requirements, is $15 million increased capital costs over a five year period and $3 million in increased annualized costs in the fifth year. Based on this estimate of the national economic impact, the promulgated standards would have no significant effect on the supply and demand of grain or grain products, or on the growth of the domestic grain industry.

2.5.2 Energy Impact

A number of commenters believed that the energy impact associated with the proposed standards had been underestimated and that the true impact would be much greater. As pointed out above, the major reason for this disagreement is probably due to the fact that these commenters assigned the full impact of air pollution control to the proposed standards, whereas the impact associated with compliance with existing State and local air pollution control requirements should be subtracted. In the example discussed above concerning costs, the additional energy requirement associated with the promulgated standards is simply the difference in energy required to operate a fabric filter baghouse compared to a cyclone.

For emission control equipment such as cyclones and fabric filter baghouses, energy consumption is directly proportional to the pressure drop across the equipment. It was assumed that the pressure drop across a cyclone required to comply with existing State and local requirements would be about 80 percent of that across a fabric filter baghouse required to comply with the promulgated standards. This is

equivalent to an increase in the energy consumption required to operate air pollution control equipment of about 25 percent. This only represents an increase of less than 5 percent in the total energy consumption required to operate a grain elevator.

Assuming 200 grain elevators become subject to the promulgated standards over the next five years, this energy impact will increase national energy consumption by less than 10,000 barrels per year in 1982. This amounts to less than 2 percent of the capacity of a large marine-going oil tanker and is only a small increase in energy consumption.

2.6 MODIFICATION

Many commenters were under the mistaken impression that all existing grain elevators would have to comply with the proposed standards and that retrofit of air pollution control equipment on existing facilities within grain elevators would be required. This is not the case. The proposed standards would have applied only to new, modified, or reconstructed facilities within grain elevators. Similarly, promulgated standards apply only to new, modified, or reconstructed facilities and not existing facilities.

Modified facilities are only subject to the standards if the modification results in increased emissions to the atmosphere from that facility. Furthermore, any alteration which is considered routine maintenance or repair is not considered a modification. Where an alteration is considered a modification, only those facilities which are modified have to comply with the standards, not the entire grain elevator. Consequently, the standards apply only to major alterations of individual facilities at existing grain elevators which result in increased emissions

to the atmosphere, not to alterations which are considered routine maintenance and repair. Major alterations that do not result in increased emissions, such as an alteration where existing air pollution control equipment is upgraded to maintain emissions at their previous level, are not considered modifications.

The following examples illustrate how the promulgated standards apply to a grain elevator under various circumstances. The proposed standards would have applied in the same way.

(1) If a completely new grain elevator were built, all of the affected facilities would be subject to the standards.

(2) If a truck unloading station at an existing grain elevator were modified by making a capital expenditure to increase unloading capacity and this resulted in increased emissions to the atmosphere in terms of pounds per hour, then only that affected facility (i.e., the modified truck unloading station) would be subject to the standards. The remaining facilities within the grain elevator would not be subject to the standards.

(3) If a grain elevator contained three grain dryers and one grain dryer were replaced with a new grain dryer, only the new grain dryer would be subject to the standards.

The initial assessment of the potential for modification of existing facilities concluded that few modifications would occur. The few modifications that were considered likely to take place would involve primarily the upgrading of existing country grain elevators into high throughput grain elevator terminals. A large number of commenters, however, indicated that they believed many modifications would occur and that many existing grain elevators would be required to comply with the standards.

To resolve this confusion and clarify the meaning of modification, a meeting was held with representatives of the grain elevator industry to identify various alterations to existing facilities that might be considered modifications. A list of alterations was developed which frequently occur within grain elevators, primarily to reduce labor costs or to increase grain handling capacity, although not necessarily annual grain throughput. The impact of considering four of these alterations as modifications, subject to compliance with the standards, was viewed as unreasonable. Consequently, they are exempted from consideration as modifications in the promulgated standards.

In particular, the four alterations within grain elevators which are specifically exempt from the promulgated standards are (1) the addition of gravity load-out spouts to existing grain storage or grain transfer bins; (2) the addition of electronic automatic grain weighing scales which increases hourly grain handling capacity; (3) the replacement of motors and drive trains driving existing grain handling equipment with larger motors and drive trains which increases hourly grain handling capacity; and (4) the addition of grain storage capacity with no increase in hourly grain handling capacity.

If the first alteration were considered a modification, this could require installation of a load-out shed thereby requiring substantial reinforcement of the grain storage or grain transfer bin to support the weight of emission control equipment. In light of the relatively small expenditure usually required to install additional gravity load-out spouts to existing grain storage or transfer bins, and the relatively large expenditure that would be required to install a load-out shed or to reinforce the storage or transfer bin, consideration of this

sort of alteration within an existing grain elevator as a modification was viewed as unreasonable.

Under the general modification regulation which applies to all standards of performance, alteration two, the addition of electronic automatic grain weighing scales, would be considered a change in the method of operation of the affected facility if it were to increase the hourly grain throughput. If this alteration were to increase emissions to the atmosphere and require a capital expenditure, the grain receiving or loading station whose method of operation had changed (i.e., increased grain throughput) would be considered a modified facility subject to the standards. Consideration of this type of alteration, which would result in only minor changes to a facility, is viewed as unreasonable in light of the relatively high expenditure this could require for existing grain elevators to comply with the standards.

Alterations three and four, replacement of existing motors and drives with larger motors and drives and addition of grain storage capacity with no increase in the hourly grain handling capacity, would probably not be considered modifications under the general modification regulation. Since it is quite evident that there was considerable confusion concerning modifications, however, alterations three and four, along with alterations one and two discussed above, are specifically exempt from consideration as modifications in the promulgated standards.

The modification provisions in 40 CFR 60.14(e) exempt certain physical or operational changes from being considered as modifications, even though an increase in emission rate occurs. Under 40 CFR 60.14(e)(2),

if an increase in production rate of an existing facility can be accomplished without a capital expenditure on the stationary source containing that facility, the change is not considered a modification.

A capital expenditure is defined as any amount of money exceeding the product of the Internal Revenue Service (IRS) "annual asset guideline repair allowance percentage" times the basis of the facility, as defined by section 1012 of the Internal Revenue Code. In the case of grain elevators, the IRS has not listed an annual asset guideline repair allowance percentage. Following discussions with the IRS, the Department of Agriculture, and the grain elevator industry, the Agency determined that 6.5 percent is the appropriate percentage for the grain elevator industry. If the capital expenditures required to increase the production rate of an existing facility do not exceed the amount calculated under the IRS formula, the change in the facility is not considered a modification. If the expenditures exceed the calculated amount, the change in operation is considered a modification and the facility must comply with NSPS.

Often a physical or operational change to an existing facility to increase production rate will result in an increase in the production rate of another existing facility, even though it did not undergo a physical or operational change. For example, if new electronic weighing scales were added to a truck unloading station to increase grain receipts, the production rate and emission rate would increase at the unloading station. This could result in an increase in production rate and emission rate at other existing facilities (e.g., grain handling operations) even though physical or operational changes did not occur. Under the present wording of

the regulation, expenditures made throughout a grain elevator to adjust for increased production rate would have to be considered in determining if a capital expenditure had been made on each facility whose operation is altered by the production increase. If the capital expenditure made on the truck unloading station were considered to be made on each existing facility which increased its production rate, it is possible that the alterations on each such facility would qualify as modifications. Each facility would, therefore, have to meet the applicable NSPS.

Such a result is inconsistent with the intent of the regulation. The Agency intended that only capital expenditures made for the changed facility are to be considered in determining if the change is a modification. Related expenditures on other existing facilities are not to be considered in the calculation. To clarify the regulation, the phrase "the stationary source containing" is being deleted. Because this is a clarification of intent and not a change in policy, the amendment is being promulgated as a final regulation without prior proposal.

2.7 PERFORMANCE TEST

Several commenters were concerned about the costs of conducting performance tests on fabric filter baghouses. These commenters stated that the costs involved might be a very substantial portion of the costs of the fabric filter baghouse itself, and several baghouses may be used at a moderately sized grain elevator. The commenters suggested that a fabric filter baghouse should be assumed to be in compliance without a performance test if it was properly sized. In addition, the opacity standards could be used to demonstrate compliance.

It would not be wise to waive performance tests in all cases. Section 60.8(b) already provides that a performance test may be waived if "the owner or operator of a source has demonstrated by other means to the Administrator's satisfaction that the affected facility is in compliance with the standard." Since performance tests are heavily weighed in court proceedings, performance test requirements must be retained to ensure effective enforcement.

2.8 SAFETY

In December, 1977, and January, 1978, several grain elevators exploded. These explosions were caused by a combination of fuel (grain dust is mainly organic), oxygen, and a source of ignition (such as an open flame, static electric spark, hot bearing, etc.). Several allegations were made by various individuals within the grain elevator industry contending that Federal air pollution control regulations are contributing to an increase in the risk of dust explosions at grain elevators by requiring that building doors and windows be closed and by concentrating the dust in emission control systems. Investigation of these allegations indicates that they are false.

There are no Federal regulations specifically limiting dust emissions from grain elevators which were in effect at the time of these grain elevator explosions. A number of State and local air pollution control agencies, however, have adopted regulations which limit particulate matter emissions from grain elevators. Many of these regulations were developed by States and included in their implementation plans for attaining and maintaining the NAAQS for particulate matter. Particulate matter, as a general class, can cause adverse health effects; and the NAAQS, which were promulgated by EPA on April 30, 1971, were established at levels necessary to protect the public health and welfare.

Although compliance with State or local air pollution control regulations, or the promulgated standards of performance, can be achieved in some instances by closing building doors and windows, this is not the objective of these regulations and is not an acceptable means of compliance with these regulations. The objective of State and local regulations and the promulgated standards of performance is that dust be captured at these points within grain elevators where it is generated through the use of effective hoods or enclosures with air aspiration, and removed from the building to an air pollution control device. This is the basis for the promulgated standards of performance. Compliance with air pollution control regulations and the promulgated standards of performance does not require that windows and doors in buildings be closed to prevent escape of dust and this practice may in fact be a major safety hazard.

Fabric filter baghouses have been used for many years to collect combustible dusts such as wheat flour. There have been extremely few incidences of dust explosions or fires caused by such emission control devices in the flour industry. In the grain elevator industry, no air pollution control device has been identified as the cause of a grain elevator explosion. Consequently, fabric filter baghouses, or emission control devices in general, which are properly designed, operated, and maintained do not contribute to dust explosions at grain elevators.

These conclusions were supported at a joint meeting on December 29, 1977, between representatives of EPA; the Federal Grain Inspection Service (FGIS) of the Department of Agriculture; the Occupational Safety and Health Administration (OSHA); the grain elevator industry; and the fire insurance industry. Installation and use of properly designed, operated, and maintained air pollution control systems were found to be

consistent with State and local air pollution regulations, OSHA regulations, and national fire codes. Chapter 6 of the National Fire Code for Grain Elevators and Bulk Grain Handling Facilities (NFPA No. 61-B), which was prepared by the National Fire Protection Association, for example, recommends that "Dust shall be collected at all dust producing points within the processing facilities." The code then goes on to specially recommend that all elevator boots, automatic scales, scale hoppers, belt loaders, belt discharges, trippers, and discharge heads, and all machinery such as cleaners, scalpers, and similar devices be provided with enclosures or dust hoods and air aspiration.

Consequently, compliance with existing State or local air pollution regulations, or the promulgated standards of performance, will not increase the risk of dust explosions at grain elevators if the approach taken to meet these regulations is capture and control of dust at those points within an elevator where it is generated. If, however, the approach taken is merely to close doors, windows, and other openings to trap dust within the grain elevator, or the air pollution control equipment is allowed to deteriorate to the point where it is no longer effective in capturing dust as it is generated, then ambient concentrations of dust within the elevator will increase and the risk of explosion will also increase.

The House Subcommittee on Compensation, Health, and Safety is currently conducting oversight hearings to determine if something needs to be done to prevent these disastrous grain elevator explosions. The FGIS, EPA, and OSHA testified at these oversight hearings on January 24 and 25, 1978. The testimony indicated that dust should be captured and collected in control devices in order to reduce the incidence of dust explosions at grain elevators, protect the health of employees from such

ailments as "Farmer's Lung," and prevent air pollution. Consequently, properly operated and maintained air pollution control equipment will not increase the risk of grain elevator explosions.

OSHA issued a hazard alert in January, 1978, concerning dust explosions at grain elevators. This hazard alert is included in Appendix I. The FGIS also issued safety guidelines in January, 1978, for determining whether a grain elevator is safe for an FGIS grain inspector to work in. These guidelines are included in Appendix II. The National Fire Protection Association guidelines which pertain to grain elevators are included in Appendix III.

Table 1

(A) Applicability	Proposed Standard	Promulgated Standard
	1. Farm elevators country elevators, grain elevator terminals, and commercial rice dryers, with a total receiving leg capacity of more than 10,000 bushels per hour which handle or process wheat, corn, milo, rice, rye, oats, barley, or soybeans.	1. Grain elevator terminals (i.e., grain elevators which have permanent grain storage capacity of over 2.5 million bushels which handle or process wheat, corn, sorghum, rice, rye, oats, barley, or soybeans.
	2. Grain storage elevators at wheat flour mills, wet corn mills, dry corn mills (human consumption), rice mills, and soybean oil extraction plants, which handle or process wheat, corn, milo, rice, rye, oats, barley, or soybeans.	2. Grain storage elevators at wheat flour mills, wet corn mills, dry corn mills (human consumption), rice mills, and soybean oil extraction plants, which handle or process wheat, corn, sorghum, rice, rye, oats, barley, or soybeans and which have a grain storage capacity of over 1 million bushels.

(B) Limits of Standard and Basis

Affected Facility	Emission Limit	Basis*	Emission Limit	Basis*
1. Fugitive Emissions				
A. Truck loading	10% opacity	Two-sided shed with one end open, the other fitted with doors. Ventilation of loading spout to control device.	Same as proposed	Same as proposed
B. Truck unloading	0% opacity	Two-sided shed with one end open, the other fitted with doors. Ventilation of receiving hopper to control device.	5% opacity	Same as proposed
C. Boxcar and hopper car loading	0% opacity	Two-sided shed with ventilation of loading spout to control device.	5% opacity	Same as proposed
D. Boxcar and hopper car unloading	No visible emissions	Four-sided shed, both ends fitted with doors. Ventilation of receiving hopper to control device.	5% opacity	Two-sided shed, both ends open. Ventilation of receiving hopper to control device.

* The standard does not mandate the use of specific equipment indicated as "basis." Any equipment meeting the emission limit or any equipment that is shown to be equivalent in controlling particulate matter is acceptable.

Table 1 (continued)

Affected Facility	Proposed Standard: Emission Limit	Proposed Standard: Basis*	Promulgated Standard: Emission Limit	Promulgated Standard: Basis*
E. Barge or ship loading	10% opacity loading 15% opacity topping-off	Choke feed with loading ventilated to control device.	20% for all loading operations	Same as proposed
F. Barge or ship unloading	Equipment standard	Marine leg enclosed from top to bottom of leg, with ventilation flow rate of both leg and receiving hopper of 40 cubic feet of air per bushel of grain unloaded.	Same as proposed	Same as proposed
G. Grain dryer	0% opacity or equipment standard	1. Column dryer - use perforated plates with hole sizes no larger than 0.084 inch diameter. 2. Rack dryer - use of 50 mesh or finer screen.	Same as proposed	1. Column dryer - use of perforated plates with hole sizes no larger than 0.094 inch diameter. 2. Rack dryer - same as proposed.
H. Grain handling	0% opacity and 0.01	Enclosed and ventilated legs, scales, trippers, and transfer points.	Same as proposed	Same as proposed
2. Emission Control Device on Air Ventilated from Affected Facilities	0% opacity and 0.01 grain per dry standard cubic foot	Fabric filter baghouse	Same as proposed	Same as proposed

(C) Modification

All modifications were covered.

1. Modification does not cover the following:
   A. The addition of gravity load-out spouts to existing grain storage transfer bins.
   B. The installation of automatic grain weighing scales.
   C. Replacement of motor and drive units driving existing grain handling equipment.
   D. The installation of storage capacity with no increase in hourly grain handling capacity.
2. Lists the "annual asset guideline repair allowance" percentage at 6.5%.
3. Only apply expenditures to an affected facility in determining whether a capital expenditure has been made.

*The standard does not mandate the use of specific equipment indicated as "basis." Any equipment meeting the emission limit or any equipment that is shown to be equivalent in controlling particulate matter is acceptable.

REFERENCES

1. "Standards Support and Environmental Impact Statement - Volume I: Proposed Standards of Performance for Grain Elevator Industry", U. S. Environmental Protection Agency - OAQPS, EPA-450/2-77-001a, Research Triangle Park, North Carolina, January, 1977.
2. "Draft - For Review Only: Evaluation of Public Comments: Standards of Performance For Grain Elevators" U. S. Environmental Protection Agency - OAQPS, Research Triangle Park, North Carolina, August, 1977.
3. "Standards Support and Environmental Impact Statement - Volume II: Promulgated Standards of Performance for Grain Elevator Industry", U. S. Environmental Protection Agency - OAQPS, EPA-450/2-77-001b, Research Triangle Park, North Carolina, April, 1978.

APPENDIX I

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration
WASHINGTON, D.C. 20210

Office of the Assistant Secretary

Dear Employer:

Within the past month grain elevator explosions in Louisiana, Texas, Illinois, and Mississippi have taken the lives of more than 50 people. An additional fifty or more workers have been hospitalized for injuries suffered in these incidents. In an effort to prevent other deaths and injuries, I am issuing the enclosed Grain Elevator Hazard Alert and urging employers to take immediate actions to safeguard their employees. The enclosed material describes the nature of grain elevator hazards, steps that can be taken, the role of Federal and State job safety and health officials, and sources of assistance available to employers seeking to protect their employees.

The central purpose of this Grain Elevator Hazard Alert is to provide employers, workers, and public officials with available information concerning grain elevator safety hazards in hopes of eliminating the kinds of dangers that result in explosions. In addition, however, we are providing information concerning health hazards associated with storage and distribution of grain. Some of these hazards involve worker exposure to excessive grain dust, the use of toxic fumigants, and possible worker contact with silica.

It is my strong recommendation that grain elevator operators carefully read and follow the requirements and recommendations contained in this hazard alert. Workers lives may literally depend upon your taking appropriate action. OSHA will, of course, continue to inspect grain elevators to ensure compliance with applicable standards as well as the employer's general duty to furnish a workplace free from recognized hazards causing or likely to cause death or serious harm to workers.

OSHA is working closely with the U.S. Department of Agriculture's Federal Grain Inspection Service, which has lost a number of employees in these explosions, the Environmental Protection Agency, the Food and Drug Administration and State and local officials to discover the causes of the recent explosions. As further information becomes available it shall be made public.

I ask your support in using the enclosed material to protect the lives of the workers in this industry.

Sincerely,

Eula Bingham

Eula Bingham
Assistant Secretary
Occupational Safety and Health

Enclosure

GRAIN ELEVATOR INDUSTRY

HAZARD ALERT

Prepared by the

Occupational Safety and Health Administration

Dr. Eula Bingham

Assistant Secretay of Labor

January 5, 1978

GRAIN ELEVATOR HAZARD ALERT

January 1978

I. INTRODUCTION: During the recent Christmas season major explosions occurred in grain handling facilities, killing fifty people and injuring many others. These tragic events have made it imperative that employers take immediate action to protect their employees and others present in such facilities. This Grain Elevator Hazard Alert is designed to assist employers in meeting their responsibilities by highlighting certain pertinent requirements and recommendations regarding hazards in this industry and their abatement.

This alert is based upon existing OSHA standards, applicable industry consensus standards, and information obtained in recent consultations among industry, government, and academic experts. As discussed below, compliance with OSHA standards is mandatory for employers subject to the provisions of the Occupational Safety and Health Act. The other elements of this Alert are offered as guidelines which employers are urged to assess and adapt to their operations. (Note: Under OSHA approved State Plans, state promulgated standards may replace Federal standards. In general, the provisions of these state standards will be similar to the Federal standards, and employers operating in such States are urged to comply with applicable State standards and regulations.)

This alert contains information about both safety and health hazards. Although the immediate concern is eliminating conditions that might cause explosions, serious health hazards such as grain dust and toxic substances also exist in grain elevators and may, over the long-run, cause many more deaths than result from the kind of dramatic catastrophes that recently occurred. Thus, considerable information is included concerning hazards to workers and their abatement; further information on such health hazards may be provided at a later date.

OSHA is providing this Alert to employers, workers, certain public officials, and members of the general public concerned about this problem. In addition to approximately 10,000 grain elevators in the United States, the Alert is being sent to unions representing workers in the industry, all OSHA Area Offices, the U. S. Department of Agriculture's Federal Grain Inspection Service, other interested Federal agencies, State occupational safety and health officials, States providing on-site consultative services to employers through contracts with OSHA, numerous colleges and universities, and anyone requesting copies of the document.

Investigations of the recent explosions by OSHA and other governmental agencies are underway but may not be complete for several weeks. The results of those investigations will be made public and may be the subject of a second Alert if the findings so warrant.

II. EMPLOYER RESPONSIBILITY:

The Occupational Safety and Health Act of 1970 requires employers to furnish each employee a place of employment free from recognized hazards likely to cause death or serious physical harm. Employers are also mandated to comply with occupational safety and health standards promulgated under the Act.

In later sections of this Alert, certain safety and health hazards associated with grain elevators are discussed and detailed requirements and recommendations are presented. Employers are required to comply with the specific standards and are urged to comply with the recommendations that apply to their operations. OSHA also strongly recommends, however, that compliance on these matters be but a part of a comprehensive safety and health program designed by each employer for each of his facilities.

Guidance on the overall design of comprehensive safety and health programs is available from a variety of sources, some of which are discussed below. Because of the nature of the hazards in this industry, OSHA recommends that special attention be given by grain elevator operators to the following matters in setting up such a program:

1. Preventive Maintenance:

A preventive maintenance program is a vital part of an overall grain elevator safety and health program. Written, established and implemented procedures for regular inspections of all mechanical and electrical machinery and equipment is strongly recommended. Standard operating procedures (SOP) should be established and conveyed to all employees affected regarding lockout and tagout procedures when machinery is down for repair or replacement.

2. Housekeeping: Housekeeping, as discussed in detail in later sections, is especially important in facilities where combustibles and the danger of their explosion is present. Written and enforced SOP's are needed to ensure adequate housekeeping.

3. Training: The need for training is never ending. All new employees should be made aware of the company or co-op policies and operating rules, especially the established safety and health procedures. Refresher training of experienced employees in the hazards of the job is important.

Employees should be informed of their rights under the Occupational Safety and Health Act.

SOP's and frequent drills are needed for fire alerts, for evacuation procedures due to bomb threats or fire, for emergency treatment (first aid) cases.

4. Outside Contractors: Special attention must be devoted to outside contractors hired to enter and perform work in a grain elevator. While contractors, as employers themselves, are obliged to provide their employees with safe working conditions, grain elevator operators are urged to ensure that contractors and their employees understand the hazards of the grain elevator environment and company safety and health rules. Uninformed or careless contractors may be more likely to violate basic safety procedures, such as not using explosion proof electrical tools or welding in unsafe environments.

5. Liaison with local safety agencies: Elevator operators should be in close contact with fire and rescue agencies and other appropriate local agencies that may assist in cases of emergency or that can provide advice and assistance in identifying and abating hazards. Employees should be trained in the means of contacting fire and rescue agencies under emergency conditions.

6. Health Hazard Control: Because of the nature of the hazards in the industry, preplacement physicals for all new employees are strongly advised, including determinations of susceptibility of allergic reactions to commonly encountered materials in grain elevator operations. Active monitoring of potential health hazards is necessary on a periodic basis so as to maintain good control of the environment.

The company policy implementing the program cannot by itself work the necessary results for a safe and healthful work environment; it requires the cooperation of all levels of management and employees, insurance and government. Good communications is necessary among the various parties for any program to be successful.

There are a number of sources of advice and assistance to employers in meeting their general and specific obligations. OSHA Area Offices, located in every State, will provide employers advice on locating and correcting workplace hazards, either over the telephone or at the Area Office. States operating their own occupational safety and health programs will provide similar off-site advice. A list of relevant State agencies is attached. In addition, thirty-nine States provide on-site consultation, in which State employees visit the worksite and point out hazards and methods or correction, where possible, without applying citations or penalties. This service is provided upon request by employers, with preference given to small business employers. (A list of these States is attached). OSHA's General Industry Standards are available at all Federal or State OSHA offices. Also available there are copies of the National Electric Code, the NFPA consensus standards (NFPA 61-B, 57, 77) and certain publications concerning grain elevators. An Iowa State University publication entitled, Literature Survey of Dust Explosions in Grain Handling Facilities: Causes and Prevention (March, 1976), is an extremely useful source book. Local offices of the federal Grain Inspectionservice and EPA can also help employers with some facets of the grain elevator work enviornment.

III. Explosion and Fire Hazards

A. The Anatomy of an Explosion

Any open flame, spark or hot surface such as an overheated bearing or welding may be capable of igniting dust. The nearly instantaneous burning of a cloud of dispersed dust constitutes an explosion. This ignited cloud releases heat energy plus a pressure wave (shock wave), which can dislodge additional dust. This often results in further explosions of increasing severity. Present literature indicates a minimum explosible concentration of grain dust to be approximately 0.04 oz./ft.3 (40.0 gm/m3). Such a concentration can be described visually as similar to dense fog.

B. Major Fire Hazards in Grain Elevators.

The accumlations of layers of dust in a workplace facility present a severe fire hazard. As an example, a heated surface will ignite a mixed grain dust layer at about one-half the temperature required for similar ignition of a grain dust cloud. Dust layers will char or burn and the charring or burning of a dust layer will generate heat and air turbulence which may trigger an initial explosion.

Grain dust is generated at all handling and conveying locations within the elevator. This dust will accumulate throughout the elevator unless it is carried off by an efficient dust collection system designed for the capacity of the grain elevator and removed by regular housekeeping procedures or The greater the concentration of combustible dust in a grain elevator the greater likelihood of a severe fire or explosion.

Other potential fuel sources that may occur occasionally in grain elevators derive from decomposition of grain causing the generation of flammable vapors. Moisture in grain, if exceeding 20 % by weight, will cause deterioration and the generation of decomposition products. Some of the decomposition products produced are methanol, propanol, butanol, 2 methyl butanol, and others, all of which are flammable if found in sufficiently high concentration. In addition to these flammable vapors, the major fumigants used with grain contain some flammable constituents such as carbon disulfide, ethylene dichloride, and (in the case of Aluminum Phosphide) phosphine. See table two for the flammable properties of these substances.

C. Major Fire Ignition Sources in Grain Elevators.

The ignition hazards capable of starting fires or explosions have been mentioned in numerous pieces of literature. The most prevalent are:

1. Open flames such as lighters, matches, burning cigarettes.
2. Slipping belts on bucket elevators and other conveyors.
3. Hot surfaces including light bulbs, hot bearings, radiators, electrical appliances, slipping V-belts.
4. Sparks from foreign material or metal parts of rotating machinery, mills or grinders.

5. Electric sparks generated during operation of switches, fuses blowing, damage to cables or equipment.

6. Static electricity.

7. Welding, cutting, soldering.

8. Spontaneous ignition in grain storage bins.

9. Lowering portable lamps into bins.

Although the ignition sources for the majority of grain elevator dust explosion experiences in the United States since 1958 are unknown, the principal known ones are welding and torch cutting operations together with hot surfaces caused by friction, slipping belts, and smoldering fires. The actual recorded causes of grain elevator explosions for the period 1958 through 1975, expressed as a percentage of the total, are as follows:

Cause	Percent
Unknown	62.0%
Welding-Cutting	10.2%
Friction	8.8%
Fire or Flame	8.0%
Electrical Equipment	6.6%
Lightning	2.9%
Spontaneous Combustion	1.5%

Source: Literature Survey of Dust Explosions in Grain Handling Facilities: Causes and Prevention (Iowa State University, March 1976)

It is generally believed that the bucket elevator is the location in the grain elevator complex in which fires most frequently occur. Some causes being slipping belts, tramp metal, overheated bearings, metal buckets scraping nearby surfaces, and static generation. Grain driers, which are located adjacent to the grain elevator, also have a significant number of fires.

D. Required and Recommended Control Procedures for Fuel Sources.

1. Maintenance

The need for a comprehensive maintenance program is the single most important aspect of a program for controlling fuel and ignition sources. Maintenance via good housekeeping practices in removing dust accumlation and through keeping mechanical and electrical equipment in good running condition is essential. During grain handling operations, dust accumulations should be removed daily. If the elevator is working 24 hours a day, then removal may be necessary several times each day.

In removing dust accumulations the creation of airborne dust should be minimized. The use of approved vacuum cleaners, is the preferred method. The practice of sweeping a work level, allowing the dust to drop to the next lower level, sweeping off that level and again allowing the dust to drop, is not an acceptable practice.

1. Dust Collection System

The efficiency of the dust collection system is an important factor in the control of dust. State agencies concerned with dust emissions, EPA and OSHA and the Federal Grain Inspection Service (FGIS) are all concerned with the effectiveness of the dust collection system. OSHA has a twofold interest in a good dust collection system. First, the system can be used to minimize the amount of dust which represents an inhalation hazard; second, it can be effective in minimizing the dust accumulations which are one recognized source of fire hazards. Present indications are that most existing systems use only single stage (fabric filters) for dust collection with subsequent return of the collected material to the elevator.

In the exploratory technical meeting held by EPA and OSHA on December 30, 1977, in Washington, D.C., OSHA was made aware of some preliminary findings regarding a two stage filtering system. The initial stage is a cyclone which removes the larger particles (those with greater mass) and returns them back to the elevator facility. The lighter and smaller dust particles are then passed to the second stage filter and removed by a fabric filter. The reported method removes particle sizes of 20 microns or less. A portion of these small particulates constitutes a respirable dust hazard. The present practice of using single-stage collection systems dictates the return of all collected particles back into the elevator. This practice of repetitively handling small particulates produces a dryer concentrated collection of small particulates that are more easily ignitable. Not only does this practice increase their ignition sensitivity, but by putting the particulates back into the elevator the health hazards are increased. OSHA recommends that every operator reevaluate present dust collection systems with the objective of removing small particulates from the collected material being returned to the elevator.

E. Required and Recommended Control Procedures for Ignition Sources

A preventive maintenance program is a vital part of the overall company safety and health program. Written and implemented procedures for regular inspections of all mechanical and electrical machinery and equipment are necessary. Standard operating procedures (SOP) should be established and conveyed to all employees affected regarding lockout and tagout procedures when machinery is down for repair or replacement. Obviously, a common sense approach dictates the prohibition of smoking, use of lighters and other open flames, non-approved coffee pots and other electrical eqiupment, in the areas of the facility where dust may accumulate.

1. Bucket Elevator

(a) To minimize fire in the area of the bucket elevator the following recommendations are made. Carefully evaluate the present operating condition of the bucket elevator.

(b) A belt slippage indicating device that can be seen from the operator's station should be installed on bucket elevators.

(c) An audible alarm should be installed to activate when the speed of the elevator falls to 80-95% of its normal operating speed.

(d) A system shutdown sequence with the following steps should be used: Upon activation of the audible alarm, the feed belt conveyors would be automatically shut down; a time delay should be established which permits operation of the bucket elevator but prevents the ignition or separation of the belt. The time delay should not exceed the time required for the bucket elevator to clear itself of grain or for the individual closest to the elevator to respond to the alarm. The audible alarm should continue throughout the time delay. The bucket elevator should shut down automatically following the termination delay.

(e) Tramp metal collectors are recommended to remove at least the ferrous materials. Depending on the volume of grain handled, the operator should establish a regular schedule for cleaning off the collected metals from the magnets. When replacing a bucket elevator belt it should be replaced with a conducting belt (to minimize static electrical charge) of low flammability and with nonmetal buckets.

2. Grain Driers.

Although grain driers are usually located separately from grain elevators, there have been numerous fires in grain driers. The following precautions are based on the recommendations contained in NFPA 61-B:

(a) Driers should be constructed of noncombustible material.

(b) Expansion joints should be provided to prevent damage from expansion or contraction.

(c) The primary intake air of the burners should be screened to prevent foreign material from entering.

(d) Driers designed to recirculate a portion of the exhaust air should employ a means of removing combustible particulate material from the air in the recirculation duct.

(e) In a direct-fired drier using oil or solid fuels, a target plate or other effective means should be used to prevent burning materials from entering the drying chamber.

(f) The interior surfaces of driers should be designed to facilitate cleaning.

(g) Access doors or openings should be provided to permit inspection, cleaning, and maintenance, and also to permit effective use of extinguishing equipment in all parts of the driers and the connecting spouts or conveyors.

(h) Means should be provided to rapidly unload (dump) the drier to a safe area in case of fire.

(i) Drying processes conducted in buildings which are likely to contain combustible dust should have heating devices and blowers located in a separate dust-tight room or area. Such rooms or areas should not communicate with portions of a building subject to dust. Surfaces of structural members and all other objects in the area should be designed to reduce to a minimum any accumulation of dust.

(j) Automatic means should be provided the drier and its auxiliary equipment in order that it will shut-down the fuel supply in the event of a fire or the development of excessive heat within the drier.

(k) A maximum temperature thermostat should be located between the heat-producing device and the drier. Also, driers should have a thermostat to control induced air temperatures inside the drying compartment.

(l) Extraneous material which contributes to the hazard of the drying operation should be removed from the product prior to entering the drier.

(m) Driers processing material containing vegetable oils should have the accumulation of oil film removed from dryer surfaces to prevent the formation of an adhesive or combustible surface.

3. Welding and Cutting Operations.

Welding and cutting operations require some special consideration. The present OSHA welding and cutting standards have application to locations where combustible dust is present. These operations have been the source of ignition for a number of explosions in grain elevators. Those welding contractors who are hired to come into the elevator to make repairs or perform maintenance work must be informed of the company regulations and of the hazards of the work location. The contractors should ensure that their employees are informed. The preferred way is to remove the object to be welded to an outside location away from the elevator. Where this cannot be done,then all dust accumulations and other fire hazards (fuel sources) in the vicinity shall be removed. Whenever floor or wall openings exist through which sparks or slag might drop, precautions should be taken to prevent this occurrence. For grain elevator operations a fire watch person is necessary for almost all welding and cutting operations. The fire watch person must be equipped and trained in the use of portable fire extinguishers and the hazards of the location. The use of the written welding permit system administered by the grain elevator operator is highly recommended by OSHA as a control against unauthorized welding and cuting. OSHA prohibits welding or cutting in those areas where dust accumulations are present or equipment is operating causing dust to be present. Conveyor equipment should be shut down that is adjacent to the welding or cutting operations.

4. Electrical Machinery and Equipment.

(a) Equipment installed in hazardous dust locations shall not permit arcs, sparks or heat otherwise generated or liberated inside of the equipment, or equipment enclosure, to cause ignition of exterior accumulations or atmospheric suspensions of agricultural dust on or in the vicinity of the equipment or equipment enclosure. Equipment so installed shall be able to function at full rating without developing surface temperatures high enough to cause excessive dehydration or gradual carbonization of any agricultural dust deposits that may occur.

Operators shall use only electrical motors, switches, fuse boxes, wiring, light fixtures and lamps which conform to OSHA 1910.309 or NEC 500 and 502 for Class II (Dusts) Group G (Agricultural Dusts) specifications in either Division 1 or Division 2 locations.

As in the case with all electrical equipment to be used in hazardous dust locations, motors, generators and other rotating electrical machinery must be approved for Division 1 locations (basically dust clouds the minimum explosive concentrations continually, intermittently, or periodically) and Division 2 locations (basically dust in hazardous layers). In Division 1 locations, motors, generators and other rotating electrical machinery shall be approved for the location and be dust-ignition-proof or totally enclosed pipe-ventilated. In Division 2 locations, motors, generators and other rotating electrical machinery shall be dust-ignition-proof or totally enclosed pipe-ventilated for which maximum surface temperatures shall not exceed 120° C (248° F). All motors, generators and rotating electrical machinery shall be in accordance with OSHA 1910.309, NEC 502-3.

(b) In areas where lightning disturbances have been known to occur, wiring systems in hazardous dust locations shall be, when supplied from overhead lines, suitably protected against high-voltage surges. This protection shall include suitable lightning protective devices, interconnection of all grounds, and surge-protective capacitors. Employers shall provide proper lightning and surge voltage protection in accordance with OSHA 1910.309, NEC 502-3.

(c) Heat sensors and automatic audible alarm systems, approved for the purpose, should be used to warn against overheated bearings or other hot spots on electric motors, belts, pulleys, or wherever locations are susceptible to overheating. Alarm and signal systems shall be used in accordance with OSHA 1910.309, NEC 502-14.

(d) The exposed noncurrent-carrying metal parts of equipment, such as the frames or metal exteriors of motors, fixed or portable lamps or other utilization equipment, lighting fixtures, cabinets, cases and conduit shall be grounded in accordance with OSHA 1910.309, NEC 502-16.

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(e) Static electricity can sometimes become the ignition source for an explosive concentration of agricultural dust. The accumulation of such static charges shall be prevented by adequately grounding or bonding in accordance with the practices outlined in NFPA No. 77-1972. Any ground or bond that is installed in accordance with OSHA 1910.309 NEC 502-3 and 502-16 for lightning protection or power circuits, respectively, shall be adequate for protection of the same electrical equipment against static electricity.

(f) Where the installation of transmitting or receiving antennas on the top of grain elevators cannot be avoided, all antenna masts and metal support structures shall be permanently and effectively grounded and the complete assembly installed in accordance with OSHA 1910.309, NEC 810 and 820.

(g) Only power tools approved for the hazardous location, and which do not present the danger of inadvertent ignition from electrical arcs or sparks, shall be used in accordance with OSHA 1910.309, NEC 250-45. Care also shall be taken to prevent any intense localized heating when using such tools.

(h) Lighting fixtures and lamps for both fixed and portable lighting, including all auxiliary equipment, for use in hazardous dust locations shall be in accordance with OSHA 1910.309, NEC 502-11.

(i) Vent pipes for motors, generators or other rotating electrical machinery, or for enclosures for electrical apparatus or equipment shall be of substantial noncombustible material and shall: (1) lead directly to a source of clean air outside of buildings, (2) be screened at the outer ends to prevent the entrance of small animals or birds, and (3) be protected against physical damage and against rusting or other corrosive influences. In addition, vent pipes shall conform to OSHA 1910.309, NEC 502-9.

(j) Intrinsically safe equipment and wiring are incapable of releasing sufficient electrical energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture. Equipment and associated wiring approved as intrinsically safe may be installed in the hazardous location for which it is approved and the provisions of OSHA 1910.309, NEC 500 and 502 need not apply to such installation. Abnormal conditions will include accidental damage to any part of the equipment or wiring, insulation or other failure of electrical components, application or over-voltage, adjustment and maintenance operations, and other similar conditions.

F. Summary of Mandatory Safety Standards.

In summary, the General Industry Standards of the Occupational Safety and Health Administration (OSHA) contain the following requirements which are applicable to grain elevators:

1. Section [29 CFR] 1910.309. This section references the 1971 National Electrical Code. Article 500 (Hazardous locations) and Article 502 (Class II Locations) would be applicable. These requirements concern electrical wiring and equipment in environments containing dust.

2. Section 1910.252. This section contains requirements pertaining to welding, cutting, and brazing. The requirements concerning "Fire prevention" and "Prohibited areas" would be applicable to grain elevators.

3. Section 1910.36 and 1910.37. These sections pertain to means of egrees which are necessary for employee emergency escape.

4. Section 1910.68 which contains requirements for manlifts.

5. Sections 1910.132, .133, .135, and .136 which address personal protective equipment.

6. Section 1910.151 which contains medical and first-aid provisions.

7. Sections 1910.157, .158, .159, and 160 which address fire protection requirements.

8. Section 1910.212 which contains requirements for machine and machine guarding.

9. Section 1910.242 and .244 which address hand and portable power tools.

10. The General Duty Clause of the OSHA Act (Section 5(a)(1)). Each employer is required to furnish employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees. The general requirement covers a number of serious hazards not covered by OSHA standards. Nationally recognized consensus standards may be used to support citation of the general duty clause. An example of a consensus standard which could be used is: "Grain Elevators and Bulk Grain Handling Facilities" (NFPA - 61-B).

IV. Occupational Health Considerations and Guidelines

Commonly recognized health hazards for grain elevator employees are known via certain signs and symptoms associated with these illnesses. Symptoms following exposure to chemical hazards, such as fumigants and pesticides, include coughing, dizziness and tremors. The presence of red blood cells in the urine is a possible sign of overexposure to these chemical hazards. Contact dermatitis may develop with repeated exposure to irritant effects of some pesticides. Working with grain can also result in a parasite-caused dermatitis known as grain itch. The grain mite is the causative agent in this skin condition.

Exposure to grain dust may cause an acute allergic reaction known as grain fever. The symptoms of grain fever are chills with headache, fever, physical discomfort, gastric upset, sneezing, and sore throat lasting 24 to 48 hours. The symptoms can recur after especially heavy exposures or after exposure following a week or more away from the dust.

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Farmer's lung is another allergic respiratory disease which can be triggered by the inhalation of almost any organic dust, whose particles are smaller than 5 microns and thus able to penetrate to the periphery of the lung. In general, the most common cause of this allergic reaction is the inhalation of spores from moldy grain or hay. Symptoms include breathlessness, chills, fever, and cough which occur several hours following the initial exposure to the dust. Dyspnea (difficulty in breathing) may be so extreme as to be associated with cyanosis (blue discoloration of the skin due to oxygen deficiency). Weight loss may be pronounced. With repeated exposures emphysema may result. In addition to the inhalation hazards of gases, vapors, silica and grain dust, there are fumigant constituents such as those listed in Table 2, that can be absorbed through the skin. There is some evidence that Ethylene Dibromide (EDB) may cause sterility. EDB, has also been found to be carcinogenic in two animal species and one target organ, the stomach. In spite of the presently existing standard of 20ppm for an 8 hour time-weighted average, a reevaluation of data suggests that, at present, a safe exposure limit for EDB has not been established. Therefore, in the absence of any data to suggest a safe level, exposure to airborne concentrations should be limited to the lowest possible concentration, and skin contact should be avoided.

Carbon disulfide, carbon tetrachloride and phosphine also are present in the work environment and should be evaluated to limit exposures to the threshold limit values prescribed by OSHA.

Because of the lack of specific information on certain labels, employers should request a hazard data sheet from the manufacturer on each fumigant used. Employees should be trained to recognize the hazards of their jobs and should be monitored for exposure to contaminants. (See Figure 1 for locations of potential employee monitoring.)

Mandatory exposure limits for hazardous substances including grain dust (classified as an inert or nuisance dust) are found in Subpart Z Part 1910 of the OSHA General Industry Standards. Table 2 contains a list of some substances commonly found in grain elevators with Threshold Limit Values.

The practice of inerting storage facilities using fumigants, requires much stricter supervision and more stringent safety and health practices. Any employee entering such areas should wear positive pressure self-contained breathing apparatus, be secured by a properly anchored safety belt lifeline, and have at least one fellow employee stationed outside the hazardous area as an observer unless appropriate ventilation and monitoring of the area for contaminants (Table 2) and oxygen is undertaken prior to entry. The observer should be capable of providing rescue services and should be equipped with similar personal protective equipment. The use of breathing apparatus or respirators requires training of employees to wear the equipment properly. OSHA Program Directive 300-9 and standards 29 CFR 1910.134 provide details on the requirements for use of respirators by employees.

TABLE 1
MAJOR COMPONENTS OF SOME GRAIN FUMIGANTS

Trade Name	Ingredients	
Weevil-Cide (Weevil-Cide Co.)	Carbon tetrachloride (skin)	78.8%
	Carbon bisulfide	19.7%
	Sulfur dioxide	1.5%
Diamond Premium Brand Fumigant	Carbon tetrachloride (skin)	17.9%
	Carbon disulfide	19.2%
	Sulfur dioxide	1.0%
	Petroleum ether	1.0%
Serafume (Dow-Chem)	Carbon tetrachloride (skin)	76.5%
	Ethylene dichloride	10.0%
	Carbon bisulfide	10.0%
	Ethylene dibromide (skin)	3.5%
Coop-Weevil Killer (Farmland)	Ethylene dichloride	64.6%
	Carbon tetrachloride (skin)	27.4%
	Ethylene dibromide (skin)	5.0%
	Sulfur dioxide	3.0%
Phostoxin (Degesch Chem Co.)	Aluminum phosphide	55.0%
	Inert ingredient	45.0%
Detia	Aluminum phosphide	
	Inert	

TABLE 2
Hazardous Substances Commonly
Encountered in Grain Elevator Operations

Substance	Threshold Limit Value Or Permissible Exposure Levels			
	p.p.m.	mg/m3	Max. Ceiling Value	* LEL
2-Butanone (MEK)	200	590		2
Carbon monoxide	50	55		12.5
Carbon tetrachloride (skin)	10		200 p.p.m.	NA
Carbon disulfide	20		100 p.p.m.	100°C
Ethylene dibromide (skin)	20			NA
Ethylene dichloride	50		200	2
Methanol	200	260	50	NA
Phosphine	0.3	0.4		6
Sulfur dioxide	5	13		Dangerous Fire Hazard
Inert or Nuisance dust (e.g. grain dust)				
Respirable fraction		5		
Total		15		

NOTE: These data are excerpted from Tables Z-1, Z-2 and Z-3 in the OSHA general industry standards which are currently in effect.

* LEL = Lower Explosive Limit

To insure that employees are not buried under grain when working in s, employees should also be equipped with a safety belt lifeline, and have an ;erver present. Employees controlling grain flow should be notified of the 'k to be done before it starts. In the case of bins with movable or selective ;tribution systems, the turnheads, spouts and tripper should be locked out on those areas in which employees are working. Additionally, in those bins :h fixed distribution or fill spouts, a similar practice should be employed.

Regulations concerning eating areas, general sanitation facilities and, rmin control are also covered by OSHA standards in 29 CFR 1920.141; these quirements must be complied with.

This general information should be used to identify and eliminate grain evator health hazards.

APPENDIX II

UNITED STATES DEPARTMENT OF AGRICULTURE
Federal Grain Inspection Service
1400 Independence Avenue, SW
Washington, D.C. 20250

FGIS INSTRUCTION 370-3

INFORMATION FOR AND ACTION BY: All FGIS Employees, Chief Grain Inspectors, and Grain Industry Plant Management

Alert Guideline Procedures and Policies upon Encountering "Hazardous Conditions" in Grain Elevators

I PURPOSE

This Instruction:

A Sets forth procedures and policies when major safety violations are encountered by employees of the Federal Grain Inspection Service, (FGIS) while performing official duty in grain, rice, and commodity elevators; mills; and other facilities.

B States hazardous conditions under which the Field Office Supervisors may remove Federal employees from the facility.

C States conditions under which the Field Office Supervisors may refuse inspection because of prevailing "hazardous conditions."

D Is effective immediately upon receipt and will remain in effect until superseded.

II. ALERT GUIDELINES STANDARDS AND PROCEDURES

A Reference source and guidelines will be those portions of OSHA General Industry Standards, 29 CFR 1910; and applicable portions of the National Fire Prevention Codes, #57 and #61B. These will be utilized to determine whether facilities or portions of facilities are considered "unduly hazardous" to FGIS employees.

1. FGIS Policy

While "unduly hazardous" conditions are unabated, it shall be within the purview of the Field Office Supervisor to order Federal employees out of the facility and to withhold inspection and weighing until compliance or acceptable progress toward abatement is attained.

The OSHA Compliance Office has the responsibility for making the final determinations of "acceptable progress."

DISTRIBUTION: FGIS:IN 36002, 02029, 02269

MANUAL MAINTENANCE INSTRUCTIONS: New Instruction. File in Manual. This Instruction supersedes the verbal Instruction issued from Washington, D.C. on Thursday, December 29, 1977.

DATE: 1/6/78

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III "UNDULY HAZARDOUS CONDITIONS OR PRACTICES"

B. The following list includes, but is not limited to, conditions and practices which constitute a threat to the safety of FGIS employees while performing official duties in grain elevators, mills, or similar facilities:

1. When an elevator is in operation under the following conditions:

a. Relative humidity is less than 45% and;

b. the dust collection system is inoperable shut down for service (Evacuate - Alert Field Office Supervisor)

2. The use of portable radios, (except regulation government issue) coffee pots, electric heaters, or fans by anyone in the open elevator area. (Evacuate - Alert Field Office Supervisor)

3. Welding, torch cutting, or soldering by anyone. (Evacuate - Alert Field Office Supervisor)

4. Observation of open flames; i.e. lighters, matches, burning cigarettes, pipes, or cigars by anyone. (Evacuate - Alert Field Office Supervisor)

5. Observation of sparks from foreign objects, or metal parts, or rotating machinery, mills, or grinders, or from nails in shoes. (Evacuate - Alert Field Office Supervisor)

6. Observation of electric sparks generated during operations of switches, fuses blowing, damages to cables or equipment. (Evacuate - Alert Field Office Supervisor)

7. Observation of fire or smoke in the headhouse or in grain storage bins. (Evacuate - Alert Field Office Supervisor)

8. Observation of slipping belts on bucket elevators. (Alert Field Office Supervisor)

9. Observation of hot surfaces including light bulbs, hot bearings, slipping V-belts. (Alert Field Office Supervisor - Elevator Management

10. Observation of static electricity. (Alert Field Office Supervisor Elevator Management)

11. Observation of moving parts running through dust accumulations or grain spills. (Alert Field Office Supervisor - Elevator Management)

12. Use of unapproved portable lamps in storage bins. (Alert Field Office Supervisor - Elevator Management)

13. Poor housekeeping. (See NFPA 61B, Chapter 7) (Alert Field Office Supervisor)

14. Excessive fumigant odors. (Evacuate - Alert Field Office Supervisor

15. Observation of compressed air being used to remove dust from walls and ledges, while elevator is operating. (Evacuate - Alert Field Office Supervisor)

16. The driving wheels of the engine used for positioning railcars are permitted to spin causing sparks while on unloading pit. (Evacuate - Alert Field Office Supervisor)

IV RESPONSIBILITIES

A The Safety Office, Standardization Division, is responsible for planning and formulating the major safety and health policies and procedures of the Agency to provide a viable safety program. The Safety Office is also responsible for accident prevention and control, safety education and accident investigation and analysis to determine the FGIS operations are conducted in compliance with applicable OSHA 29 CFR Standards, National Fire Prevention Standards (NFPA) #61B and 57, and FGIS safety regulations.

The address of the Safety Office is:

Safety Office, Standardization Division
Federal Grain Inspection Service
U.S. Department of Agriculture
1400 Independence Avenue, SW
Washington, D.C. 20250
Telephone: (202) 447-9331

B Supervisors shall:

1. Be on the alert for hazardous conditions.

2. Exercise judgment in actions with safety of FGIS employees being the prime consideration.

3. Immediately contact Elevator Management on actions initiated under item III.

4. Contact OSHA Field Office.

5. Vigorously enforce all FGIS departmental safety regulations.

6. In questionable situations, time permitting, contact the FGIS Safety Office or the Employee Relations and Services Branch, Personnel Division, Agricultural Marketing Service, for assistance or concurrence

C Employees shall:

1. Observe all safety regulations and procedures.

2. Be on the alert for their personal safety.

3. Use personal protective equipment as prescribed.

4. Participate in all emergency evacuation drills and safety programs initiated by Elevator Management.

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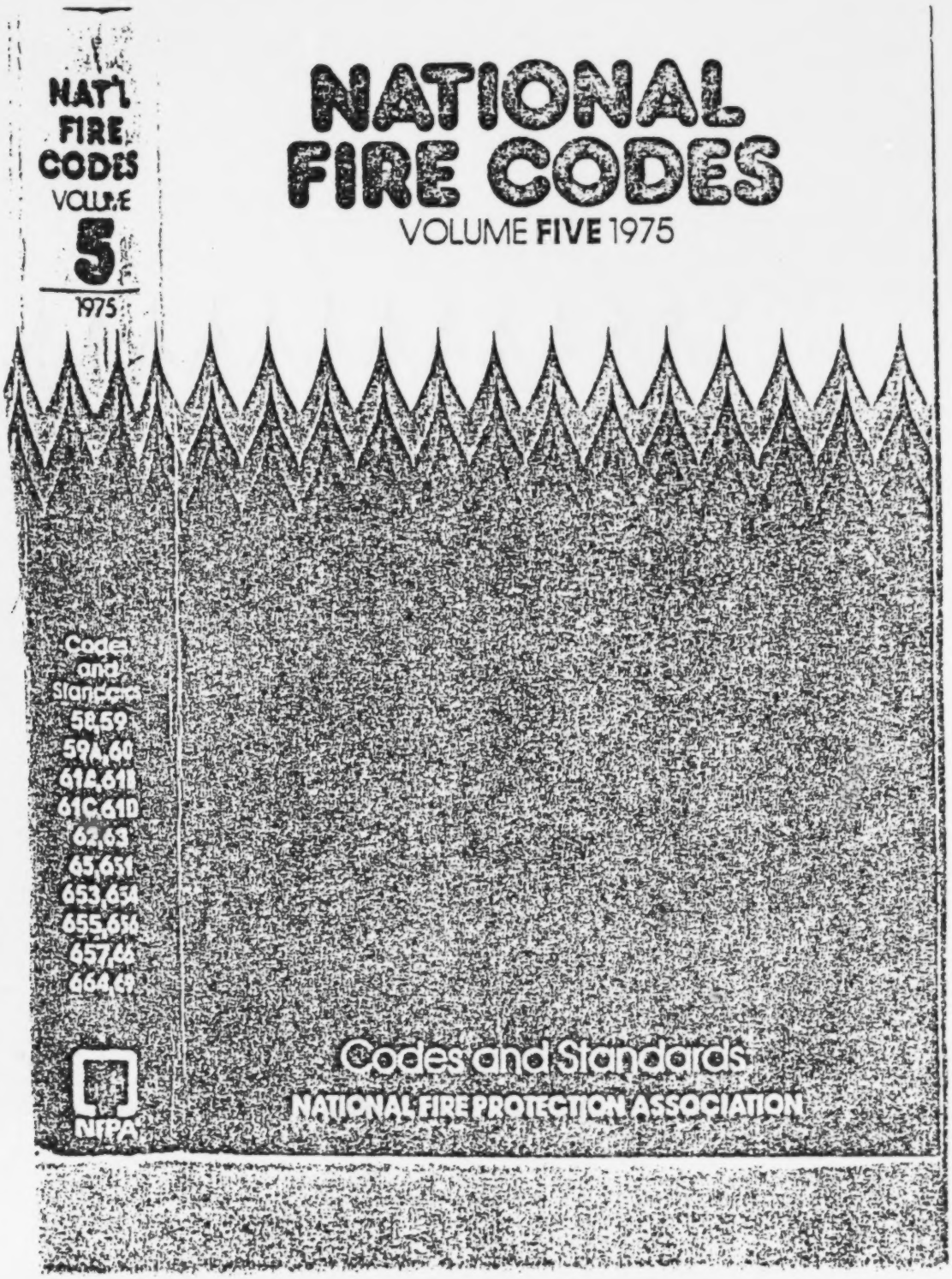
4 Promptly report all hazardous conditions, or unsafe practices to Field Office Supervisor.

5 Comply with the safety and conduct requirements as set forth in this instruction.

L. E. Bartelt

Administrator

APPENDIX III


NAT'L FIRE CODES VOLUME 5 1975
NATIONAL FIRE CODES
VOLUME FIVE 1975
Codes and standards
58,59
59A,60
61A,61B
61C,61D
62,63
65,651
653,654
655,656
657,66
664,69
NFPA
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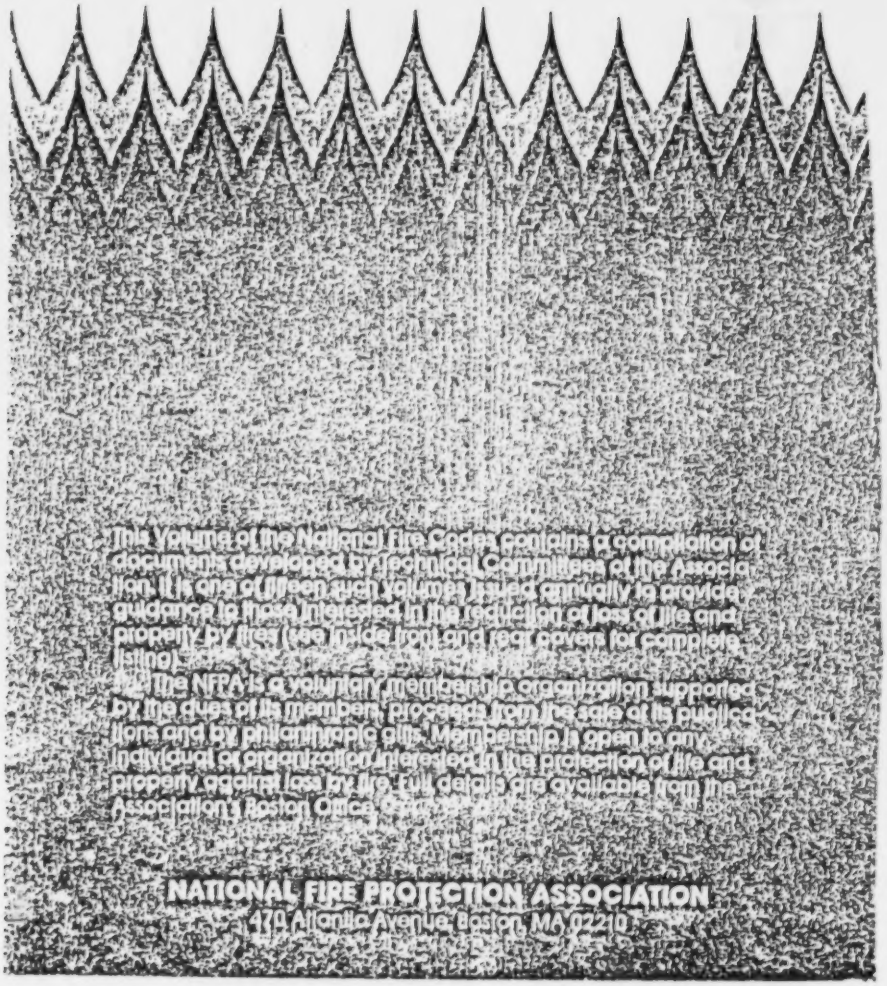
This Volume of the National Fire Codes contains a compilation of
documents developed by Technical Committees of the Associa-
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guidance to those interested in the reduction of loss of life and
property by fire. (See inside back cover for complete
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tions and by philanthropic gifts. Membership is open to any
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Association's Boston Office.
NATIONAL FIRE PROTECTION ASSOCIATION
470 Atlantic Avenue, Boston, MA 02210

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Standard for the Prevention of Fire and Dust Explosions in Grain Elevators and Bulk Grain Handling Facilities

NFPA No. 61B — 1973

1973 Edition of No. 61B

This standard was prepared by the Sectional Committee on Grain and Food Processing Dusts and was approved by the Dust Explosion Hazards Correlating Committee. This edition was adopted at the 1973 NFPA Annual Meeting and supersedes the 1970 edition.

The 1970 edition of this standard was approved by the American National Standards Institute under date of January 27, 1971 and designated ANSI Z12.4-1971. The 1973 edition is being submitted for similar approval. The ANSI designation and date of approval will be printed on the front cover of copies of this edition printed after approval has been received.

Origin and Development of No. 61B

No. 61B was adopted as a tentative standard in 1969, replacing three former standards: No. 61B, No. 64, and No. 661. The tentative standard, with amendments, was adopted as an official standard at the 1970 Annual Meeting.

Correlating Committee

T. T. Singer, *Chairman,*
Insurance Services Office — Midwestern Region, 230 W. Monroe St., Chicago, IL 60606

W. L. Sandet, *Secretary,*
Insurance Services Office — Midwestern Region, 230 W. Monroe St., Chicago, IL 60606

R. W. Andrews, Jr., American Society of Mechanical Engineers
John Nagy, U.S. Bureau of Mines and NFPA Committee on Explosion Protection Systems
G. D. Perkins, Mill Mutual Fire Prevention Bureau
James B. Walker, Jr., American Boiler Mfrs. Assn.

†Nonvoting.

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Standard for

Grain Elevators and Bulk Grain Handling Facilities

NFPA No. 61B— 1973

Notice: An asterisk(*) preceding the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix.

FOREWORD

This standard has been developed to replace three existing NFPA Codes, NFPA No. 61B, *Code for the Prevention of Dust Explosions in Terminal Grain Elevators*, NFPA No. 64, *Code for the Prevention of Dust Ignitions in Country Grain Elevators*, and NFPA No. 661, *Suction and Venting in Grain Elevators*. The purpose in consolidating the three codes retaining the important features of each, was to provide a single complete standard covering the full range of recommendations for good design, operating practices and protective features. It should be noted that trends within the industry toward utilization of various types of bulk grain storage facilities suggest that a distinction between types of grain elevators on the basis of capacity or shipping and receiving media is no longer practical.

These guidelines have been set forth representing current thinking on minimizing fire and dust explosion hazards in properties to which they apply as defined in the scope.

The Standard for Dehydrators and Dryers for Agricultural Products (NFPA No. 93) was formally withdrawn in May 1968. For this reason, Chapter 5, Grain Driers has been included.

SCOPE

This standard has two principal objectives: First, to prevent fire and dust explosions, and second, to minimize the resulting damage should a fire or explosion occur.

This standard shall apply to all facilities designed principally for receiving, shipping, handling or storing agricultural commodities such as (but not limited to) barley, corn, cottonseed, flaxseed, milo, oats, wheat, rice, safflower seed, soybeans, and similar commodities which may present a fire or dust explosion hazard.

Such facilities include grain elevators, transfer facilities with or without storage, bulk storage buildings, etc., including grain storage and handling facilities associated with processing plants. For standards applying to facilities involving further processing of agricultural commodities such as cereal mills, flour mills, or feed mills, see NFPA Standards 61A, 61C, 61D.

This standard shall apply to facilities erected subsequent to the date of this standard, and is presented as an advisory guide for owners or operators who may wish to avail themselves of the information herein contained in major replacement or renovation of existing facilities.

CHAPTER 1. STRUCTURAL FEATURES

*101. General

1011. Materials of construction shall be either noncombustible or fire resistive.

1012. Exterior walls, roofs, roof houses and galleries shall be designed in conformity with applicable local, state or national building codes.

*102. Interior Surfaces

*1021. Horizontal surfaces, particularly those that are inaccessible or difficult to clean, should be kept to a minimum to reduce the accumulation of static dust.

103 Walls

1031. Interior walls erected as fire walls, between mills, work houses, bins, driers, warehouses, track sheds, etc., shall be designed for a minimum of three hours fire resistance.

1032. Any opening in a fire wall shall be protected by approved installation of an automatic closing Class A fire door.

1033. Interior walls, erected to segregate dust-explosion hazards, shall be designed for explosion resistance that will permit proper relieving of venting areas to the outside without destruction of these walls.

1034. The use of plastic panels shall be limited to plastics having a fire hazard classification not exceeding a flame spread rating of 25 according to method of test of surface burning characteristics of building materials NFPA No. 255, UL No. 723, ASTM No. E84.

104. Bins and Tanks

1041. Bins and tanks shall be noncombustible or fire-resistive.

1042. Bins and tanks shall be provided with dust-tight and watertight covers or decks.

1043. There shall be no openings between bins or tanks.

1044. Where a bin or tank has a manhole provided in the deck or cover the smallest dimension of the opening shall be at least 24 inches and the manhole cover shall not emit dust.

***105. Stairs and Elevators**

1051. Interior stairs and elevators shall be enclosed by fire-resistive or noncombustible shafts having a fire-resistive rating of at least one hour.

1052. Stair and elevator shafts shall be protected by approved installations of automatic closing Class B fire doors on all interior openings.

***106. Marine Towers**

1061. Marine Towers shall be constructed of noncombustible materials.

1062. Movable marine towers shall be provided with adequate automatic and manual power operated brakes.

1063. Movable marine towers shall be provided with automatic and manual rail clamps. Provision shall be made for providing emergency tie-down with guy cables in areas subject to hurricanes.

CHAPTER 2. VENTILATION, VENTING AND AERATION

201. General

2011. Other chapters of this standard provide specifically for inclusion of necessary explosion relief designs and dust control. Ventilation as referred to in this chapter refers to natural heat and light venting and other air movement as may be necessary for normal industry operations and for personnel comfort and safety. Where local, state or federal regulations govern quantity or type of particulate emission to the atmosphere, the following provisions may be modified to conform with such requirements. However, any fire or explosion hazards introduced or increased by the modifications shall be provided with the protective features required by this standard.

*202. Venting of Bins and Tanks

2021. There shall be no direct structural openings between bins and tanks.

*2022. Each bin or tank, including interstices, shall be provided with means for adequate air displacement during filling or emptying. The vent shall be large enough to handle the air displaced by grain according to the fastest rate of input or removal possible with the equipment provided (24 cubic feet per minute for each 1,000 bushels per hour of grain handled — not including entrained air).

2023. Where there is a story above the bins, such vent may necessarily be located in the side of bin immediately below its top, in which case the terminal of vent shall be of special design which will not permit wind to blow into vent. No portion of vent shall be other than vertical if such arrangement is practicable, to prevent choking with accumulation of dust.

2024. If a vertical stack or air aspiration cannot be installed on a bin or tank because of interference with operation of house or because of structural conditions, the stack may be inclined not more than 30 degrees from vertical and where necessary, two or more such stacks may be connected to a common header stack and thence to the outside. Such stacks (including header) may be inclined not more than 30 degrees from vertical. There shall be no intercommunication of bins except through stacks which may necessarily join in a common header stack as above. Clean-out doors shall be provided at regular intervals in all nonvertical shafts.

CHAPTER 3. EXPLOSION RELIEF

301. General

*3011. Explosion relief as used in this standard is intended to encompass the design and installation of protective features, which by relieving the pressures resulting from a combustion explosion occurring at atmospheric pressures, will minimize damage to the building or equipment and injury to personnel.

3012. When a dust-explosion hazard exists in any building or structure, such building or structure shall be provided with explosion relief. For more complete information refer to NFPA Standard No. 91, *Guide for Explosion Venting.*

3013. Explosion relieving panels, windows, or other closures shall be designed to prevent automatic closure after relieving a pressure wave, otherwise an implosion can occur.

*302. Equipment

3021. Elevator legs shall be equipped with maximum possible explosion relief through the roof.

3022. Dust collectors shall be located outdoors or in separate buildings with the recommended explosion relief for collector and building. Where it is necessary to use filter collectors, these shall be enclosed in a metal housing which in turn shall be provided with explosion relief. Explosion relief for equipment shall be designed for the minimum of 1 square foot of relief for each 30 cubic feet of volume.

3023. Dust collection system ducts shall be provided with explosion relief in accord with NFPA Standard No. 91, *Blower and Exhaust Systems.*

3024. Explosion relief for pneumatic conveyor systems shall be provided and designed in accord with NFPA Standard No. 66, *Pneumatic Conveying Systems in Handling Feed, Flour, Grain and Other Agricultural Dusts.*

CHAPTER 4. EQUIPMENT

400. General

*401. Elevator Legs

4011. Leg casings, head and boot sections and connecting spouts shall be dust tight and constructed of noncombustible material. Plastics used as lining material for such equipment shall be limited to materials having a fire hazard classification not to exceed a flame spread rating of 25 according to method of test of surface burning characteristics of building materials NFPA No. 255, UL No. 723, ASTM No. E84.

4012. Inspection door(s) shall be located in the head section to allow full inspection of head pulley lagging and the pulley side of the leg belt, preferably on the down leg side.

4013. Leg throat shall be hoppered to the down leg at an angle of not less than 45 degrees.

4014. Legs shall be driven by individual motors and drives which shall be large enough to handle the full rated elevating capacity without being subjected to overload, but which shall not be larger than the smallest standard motor rating meeting the above requirements.

4015. If pits are necessary, ample room shall be provided for cleaning, lubricating and repairing boot.

402. Drives

4021. All elevator legs, conveyors, processing machinery, carpullers, winches, drier systems, etc., shall have individual connections to power source, and shall not be run idle.

*403. Processing Machinery

*4031. Processing machinery shall include equipment for screening, cleaning, scalping, clipping, scouring, desmutting, grinding, pulverizing, cracking, shelling, etc., but not for drying.

*4032. Tributary spouts or conveyors feeding grain processing machinery shall be equipped with a properly installed permanent or electric magnet, pneumatic separator, screen, or specific gravity-

type separator to exclude from the processing machinery all metal or foreign matter of a size larger than the grain being processed.

***404. Clutches and Drive Belts**

4041. If friction clutches are used, they shall be constructed entirely of noncombustible material.

4042. Where a belt-type drive is used, the drive shall be designed to add a sufficient service factor to stall the driving forces without slipping.

405. Screw Conveyors

4051. Screw conveyors shall be fully enclosed in metal housings, with free-lifting covers at discharge end and over each shaft coupling.

406. Bearings

4061. Roller or ball antifriction bearings shall be used on all machinery, conveyors and processing equipment.

4062. Lubrication inlets on all bearings shall be provided with dust caps or other tight closures.

***407. Spouts and Throw of Grain**

4071. Fixed spouts shall be dust tight.

4072. Portable, automatic distributing, and movable spouts are permitted in working floor, bin floor or distributing floor areas. Such spouts shall be made dust tight when in use.

4073. Open top grain chutes and open screens which permit free escape of dust shall not be used.

CHAPTER 5. GRAIN DRIERS

501. Construction of Driers

5011. General. Driers and the related equipment shall be built with regard to the hazard inherent in the equipment operating at elevated temperatures, the hazard occasioned by overheating the product, open flames, incomplete combustion of direct-fired devices, hazard to operator from mechanical equipment and high temperatures, and the need of assuring reliable, safe operation over the expected life of the equipment.

(a) Driers shall be constructed of noncombustible material.

(b) Expansion joints shall be provided, if necessary, to prevent damage from expansion or contraction.

(c) Driers designed for outdoor use shall be so constructed or anchored that they can safely withstand wind pressures or snow loads to which they may be subjected. As a minimum, driers less than 50 feet in height shall be designed to withstand wind pressures of 20 pounds per square foot. If over 50 feet, but less than 100 feet in height, this loading shall be increased to 25 pounds per square foot, and if over 100 feet, 30 pounds per square foot loading shall be used. These requirements may be modified to conform to local building codes.

(d) The primary intake air of the burners shall be screened.

(e) All driers designed to re-circulate a portion of the exhaust air shall employ a means of removing combustible material from the air in the re-circulation duct.

(f) In a direct-fired drier using oil or solid fuels, a target plate or other effective means shall be used to prevent burning materials from entering the drying chamber.

(g) Interior surfaces of all driers shall be designed to facilitate cleaning.

(h) Access doors or openings shall be provided to permit inspection, cleaning and maintenance, and also the effective use of extinguishers or hose streams in all parts of the drier and the connecting spouts or conveyors. All access doors which permit personnel entry shall be provided with hardware which will permit manual opening without tools from either side of the access door.

(i) Intake and discharge hoppers for driers shall be so designed that they will be accessible to permit cleaning in the event of stoppage.

(j) Means shall be provided to rapidly unload (dump) the drier in case of fire.

502. Electrical

5021. Electric motors shall be installed so that ventilation is provided.

*503. Location of Driers

5031. Drying processes conducted in buildings likely to contain combustible dust shall have heating devices and blowers located in a separate dust-tight room or area. Such rooms or areas shall not communicate with portions of a building subject to dust. Surfaces of structural members and all other objects in this area shall be designed to reduce to a minimum any accumulation of dust.

5032. Exhaust air from driers shall be directed to the outside.

504. Fuel Supplies

5041. Fuel supplies up to the point of connection with the drier, where applicable, shall comply with the following Standards: NFPA No. 30, *Flammable Liquids Code;* NFPA No. 31, *Standards for the Installation of Oil Burning Equipment;* NFPA No. 54, *Standard for the Installation of Gas Appliances and Gas Piping;* NFPA No. 58, *Storage and Handling of Liquefied Petroleum Gases;* NFPA No. 70, *National Electrical Code.*

505. Heat Producing Devices

5051. Combustion controls shall comply with provisions as defined in NFPA No. 86A, *Standard for Ovens and Furnaces.*

5052. Gas Fire Devices. All gas-fired heat producing devices shall be of an approved type. Heat producing devices using LP-Gas and using vaporizer burners shall comply with construction and control requirements as specified in NFPA No. 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases.*

5053. Gas burners and associated mixing equipment shall be suitable for the service intended as follows:

(a) For BTU content of gas used.

(b) For operating pressures furnished.

(c) Capable of maintaining flame stability throughout turndown range.

(d) Designed to permit use of required safety interlock.

5054. Pilots shall be of an approved type. Under conditions where reliability of direct electrical ignition of the main burner(s) is questionable, flame-type pilot ignition shall be used.

5055. Purge cycle shall accomplish at least four complete changes of air in all areas of the drier.

5056. Oil-Fired Devices. All types of heating devices that use liquid fuels shall be of an approved type.

50561. Design of the combustion chamber shall be such that combustion of the air-oil mixture will be completed within the chamber throughout the turn-down range of the control equipment.

50562. Pilots shall be of an approved type. Under conditions where reliability of direct electrical ignition of the main burner(s) is questionable, flame-type pilot ignition shall be used.

50563. Oil shall not be delivered to the burner by gravity.

5057. Heat Transfer Driers. All types of heat transfer devices that use heat transfer media such as steam, air or vapors of other media, some of which are combustible, shall comply with the following requirements:

(a) Relief valves shall be provided where necessary and relief valves on systems employing combustible liquids shall be vented to the outside.

(b) Enclosures for heat exchangers shall be of noncombustible construction with access openings for maintenance and cleaning.

(c) Heat exchangers shall not be located or arranged in such a manner that combustible dusts are likely to accumulate on the coils, fins or other heated surfaces.

506. Control Equipment

5061. Control equipment shall be of such construction and design and so arranged that required conditions of safety for the operation of the heat-producing device, the drier, and the ventilation equipment used, will be maintained. In addition to combustion and ignition controls there shall be provided automatic means for shutting down the drier and its auxiliary equipment in the event of a fire or the development of excessive heat within the drier.

5062. All control equipment shall be nonrecycling or shall accomplish a nonrecycling shutdown and require a manual reset before the drier can be again placed in operation following a safety control shutdown.

5063. A maximum temperature thermostat shall be located between the heat-producing device and the drier.

5064. Driers shall have a thermostat to control induced air temperature inside drying compartment.

5065. Driers from which the dried product moves automatically from the drier to the storage building shall have a maximum temperature limit switch located in the exhaust air stream. Driers in which the dried product moves manually should have one or more maximum temperature limit switches located in the exhaust air stream. The operation of these controls shall:

(a) Shut off all heat being supplied to the drier and shall stop the movement of air through the drier.

NOTE: Driers in which the product being dried is in air suspension shall be exempt from the requirement of stopping the movement of all air.

(b) Interrupt the flow of the product into and away from the drier.

(c) Sound an audible alarm.

5066. A control device of suitable design shall be provided which will cut off all heat being supplied to the drier should the movement of air through the drier be stopped. A device which measures air flow shall be used. Drum or rotary driers which do not employ air flow are exempt from this requirement.

507. Operation of Drier

5071. Extraneous material which contributes to the hazard of the drying operation shall be removed from the product by an approved method, prior to entering the drier.

5072. Extraneous material from the product shall be immediately removed from the vicinity of any building except it may be stored in a specially built structure.

5073. Periodic inspections of the drier interior shall be made and the unit cleaned as necessary. Driers processing material containing vegetable oils shall have the accumulation of oil film removed at frequent intervals to prevent the formation of an adhesive or combustible surface.

5074. The entire unit including the drier and burner shall be carefully inspected and a test shall be made to assure proper operation of the equipment and its controls, prior to each drying season.

5075. Manufacturers shall furnish operating instructions which will specifically indicate safe operating and processing limitations for each drier.

5076. Operating personnel shall be fully instructed in the safe operation of the drier.

5077. Drier shall be monitored while in operation.

***508. Fire Extinguishing Equipment**

CHAPTER 6. DUST CONTROL

601. Dust Collection

6011. Dust shall be collected at all dust producing points within the processing facilities.

6012. All elevator boots shall be provided with air aspiration.

6013. Automatic scales shall be provided with enclosures or dust hoods and air aspiration.

6014. Scale hoppers shall be enclosed at the top and air aspiration provided at both the top and discharge.

6015. All belt loaders shall be provided with air aspiration.

6016. Air aspiration shall be provided on all belt discharges, trippers, distributor heads, and at the end of all belts.

6017. All machinery such as cleaners, scalpers and similar devices not designed to be dust tight shall be provided with air aspiration.

602. Dust Collecting System

6021. The entire dust collecting system shall conform to NFPA No. 91, *Standard for the Installation of Blower and Exhaust Systems.*

6022. All component parts of the dust collection system located inside the elevator structure shall be of noncombustible material.

6023. Dust collectors shall be located outside of buildings or in a noncombustible room outside the grain storage and handling structure. Such building or room shall comply with all provisions set forth in NFPA No. 66, *Standard for Penumatic Conveying Systems for Handling Feed, Flour, Grain and other Agricultural Dusts.*

6024. The dust liberated by car or truck unloading, and especially where car dumpers are used shall be controlled by enclosing as much of the top of the track hoppers as possible by applying positive air aspiration to such enclosures.

6025. Dust bins shall be of noncombustible construction, detached from other buildings, equipped with a normally closed fire stop in connecting ducts and provided with suitable fire detection and extinguishing devices.

CHAPTER 7. HOUSEKEEPING

701. Good Housekeeping

7011. Good housekeeping and clean premises are the first essentials for elimination of dust explosion hazards, consequently this standard is not intended to lessen in any way the responsibility of the owner or operator in this respect. It should also be emphasized that any potential fire cause may produce a dust explosion.

*702. Removal of Static Dust

*7021. Dust on floors, ledges, girders, machinery, spouting and other surfaces, including all galleries and tunnels shall be removed concurrently with operations to prevent accumulation of such dust.

7022. Spills and chokes shall be cleaned up without delay.

7023. The use of compressed air or other means to blow dust from ledges, walls, and other areas which will create a dust explosion hazard shall not be permitted unless all machinery in the area has been shut down and all sources of ignition removed.

CHAPTER 8. ELECTRICAL

801. Wiring and Equipment

8011. Electrical equipment shall conform with the provisions of Articles 500 and 502 of NFPA No. 70, *National Electrical Code* or the *Canadian Electrical Code*, as applicable.

CHAPTER 9. FIRE PROTECTION

*901. Fire Protection

9011. Portable Fire Extinguishers. Portable fire extinguishers shall be provided throughout all buildings in accordance with NFPA No. 10, *Installation of Portable Fire Extinguishers*, with particular reference to requirements for the protection of Class C (electrical) hazards.

CHAPTER 10. MISCELLANEOUS

1001. Heating

10011. Heating shall be steam or hot water from a boiler in an approved location, or from electric hot water radiators of a type approved for Class II locations. Steam pipes exposed to dust accumulations shall be protected by suitable insulation having continuous nonporous covering or skin of adequate thickness to keep the surface temperature below 160° F.

1002. Protection Against Sparks

10021. All openings less than 50 feet above ground, in exterior walls on track or dock side, shall be protected against sparks, by screens.

*1003. Fumigation

10031. Processes and chemicals for fumigation shall be in accordance with the requirements of NFPA No. 57, *Standard for Fumigation.*

1004. Smoking

10041. Smoking shall be prohibited except in designated areas.

1005. Waste Cans

10051. Approved containers shall be provided, all oily waste and other rubbish deposited therein, and emptied daily.

1006. Oils

10061. Main storage of lubricating oil, grease and other flammable liquids shall be in a detached location. Storage of lubricating oil and grease in the elevator shall be limited to a maximum of five barrels and shall be in a separate room of noncombustible construction.

*1007. Miscellaneous Storage

10071. Storage of ammonium nitrate shall be in accordance with the provisions of NFPA No. 490, *Storage of Ammonium Nitrate.*

1008. Lightning Protection

10081. Lightning protection, if provided, shall be installed in accordance with NFPA No. 78, *Lightning Protection Code.*

1009. Static Electricity

10091. Static electricity shall be removed from such machines or equipment as accumulate a charge, by permanent ground wires, and from belts by grounded metal combs or other effective means. Grounds shall be in accordance with the provisions of NFPA No. 77, *Recommended Practice on Static Electricity.*

1010. Welding and Cutting

10101. Welding and cutting operations are potentially one of the most hazardous operations that may be conducted in grain storage and handling buildings. This is particularly true because of the combustible dust and other refuse which might be found in the immediate vicinity where welding or cutting is carried out (see NFPA No. 51B, *Standard for Fire Protection in Use of Cutting and Welding Processes*).

10102. Written permission shall be given by the manager or superintendent, or other recognized officer, before each welding or cutting job is undertaken.

10103. All machinery and dust producing operations from which dust may reach the area or within range of welding sparks shall be shut down prior to the start of the welding or cutting job and remain inoperative until the job has been completed and final inspection is made.

10104. Sweep clean and wet down floors and surroundings, including the floor immediately below before welding and cutting job is commenced.

10105. All floors or wall openings within 35 feet shall be tightly sealed to prevent passage of sparks and all combustible material which cannot be removed from the area shall be protected by suitable flameproof covers or guards.

10106. If a major welding or cutting job is to be undertaken, and the plant cannot be shut down, special requirements will be outlined as required in paragraph 10102.

10107. Inspection on Completion of Job. Flying sparks from welding are frequently thrown or fall into places where the material smolders for hours before bursting into flame. A careful inspection of all areas near the welding scene, including the floors

above and below, shall be made when the job is finished, and such areas shall be patrolled for a period long enough to make certain that no smoldering fires have developed.

1011. Powder-Operated Tools

10111. Gun-type tools using powder or cartridges for driving pegs or pins into concrete, brick, steel, etc., shall not be used where combustible dust or dust clouds are present. When the use of this type of equipment becomes necessary, all dust producing machinery in the area shall be shut down, all equipment, floors and walls shall be carefully cleaned, and all dust accumulations removed. A careful check shall be made to be sure that no cartridges or charges are left on the premises where they could enter equipment or be accidentally discharged after operation of the dust producing or handling machinery is resumed.

*1012. Outside Grain Storage

*1013. Shovels

*1014. Grain Temperature Indicators

*1015. Internal Combustion Engines

APPENDIX

This Appendix is not a part of this NFPA Standard . . . but is included for information purposes only.

A101. General: Grain storage and handling facilities should be maintained as separate fire areas from mills or other major processing installations.

A102. Interior Surfaces: Surfaces, both horizontal and vertical, should be smooth to facilitate cleaning.

A1021. Horizontal Surfaces: Inaccessible for adequate cleaning, should be inclined as steeply as possible.

A105. Stairs and Elevators: Manlifts should be enclosed and protected as required in 1051 and 1052.

A106. Marine Towers: Marine towers should be cut off or detached sufficiently from the elevator to preclude major damage to the elevator from an explosion occurring in the tower.

Movable marine towers should be provided with suitable equipment to sense wind velocities and automatically set brakes and rail clamps when wind velocities exceed 35 miles per hour.

A202. Venting of Bins and Tanks: All vents, wherever practicable, should be vertical stacks, and should be equipped with a weather hood of a type that will not permit wind to blow into the vent.

A2022. Aeration: The use of permanently or temporarily installed fans to draw or force unheated air through a silo or tank of grain which is at an elevated temperature, should include the following principles:

Temperature indication devices should be installed in bins and interstices for surveillance of grain temperatures.

When two or more bins are manifolded into a common duct for the entrance or exit of air, blast gates or equivalent shutoffs should be provided on each individual bin duct.

Where a positive pressure fan system is used to force air into a silo or tank with subsequent free air existing at the top, sufficient venting to the outside should be provided. Where sufficient outside venting is not provided, an aspirating fan to the outside should be used to prevent dust-laden air from reentering the interior of the building.

A3011. Buildings and Structures: All exterior walls and roofs above or below the bins or tanks in the workhouse and storage annex sections of the elevator, also the walls of the belt galleries and track sheds and the roofs of all buildings or sections of buildings where a dust explosion hazard may exist should be designed and constructed so as to offer the least possible resistance to explosion pressures.

Explosion relief areas should be evenly distributed through the exterior walls and roof of the room or building where grain dust may be present. The size and shape of volume to be equipped with explosion relief areas must be considered in the design of the explosion relief areas, wall explosion relief must be provided to avoid development of excessive pressures.

Large unrestricted areas should be provided with stops in the form of noncombustible partitions with self-closing doors to limit the travel of the flame-propagation wave.

All buildings should, insofar as is possible, be constructed sufficiently above grade level so that all tunnels, basement beltways or other basement work areas can be provided with the required explosion relief areas direct to the outside.

A302. Equipment: Distributors and turn-heads should have the maximum amount of explosion relief possible. The spout openings not in use in the distributor or turn-head should be closed to prevent propagation of flame through the idle spouting.

A401. Elevator Legs: Pits should be lighted and should be accessible.

Boot sections should be at or above the floor level rather than in pits and should be provided with adequate doors for cleaning out the entire boot and inspection of the boot pulley and leg belt. Such doors should be equipped with dust-tight covers which can be opened without tools.

Elevator boot sections and the spouts feeding them should be so constructed as to minimize the possibility of choking.

All elevator legs should be provided with an automatic mechanical or electromechanical device to shut off all driving power and sound an alarm in the event of belt slowdown or a separation of the leg belt. Tributary conveyors (all types) which feed the elevator leg should be equipped with an interlocking device to automatically shut off power simultaneously when power to the elevator leg is interrupted.

A403. Processing Machinery: All processing machinery should be of noncombustible materials.

A4031. All grain processing machinery should be mounted at least 8 inches above the floor to allow access for cleanup, unless such machinery is constructed with a tight base preventing grain from reaching inaccessible places beneath the machine.

A4032. Tramp Metal Removal: Grain and dry ingredient receiving facilities should be equipped with permanent magnets, approved electromagnets or specific gravity-type separators to prevent the entry of tramp metal into grain handling or processing machinery. Such devices should be installed on conveyors or spouting handling grain from truck dump hoppers, rail car hoppers barge unloading and ship unloading systems prior to the entry of the grain into subsequent conveying, elevating, or processing machinery.

A404. Clutches and Drive Belts: When drive assemblies must necessarily involve the use of belts (V-belts or flat belts), such belts should be of approved static-conduction type.

A407. Spouts and Throw of Grain: Throwing of grain in the open for considerable distances (not confined to spouts) should not be permitted, except where absolutely necessary in open or semi-confined spaces as in the case of barge loading, ship loading, or rail car loading or in large bulk grain storage areas.

Spouts introducing grain into tanks, bins or garners should be designed and installed in such a manner that the grain stream will not strike the wall of the bin, to avoid the possibility of generating sparks with entrained tramp iron.

Space Under Conveyors: At least 8 inches of clear space should be provided between return rollers supporting conveyor belts and the floor, to provide sufficient access for cleaning.

Nonchoking of Elevator Legs: All spouts, garners, bins, etc. should be designed to handle the full rated capacity of the largest

elevator leg feeding them. Such receptacles should have automatic overflow systems or be equipped with approved high-level visual or audible indicating devices.

A5030. Location of Driers: Driers and related equipment including fuel lines and fuel storage should be located with due regard to the possibility of fire resulting from overheating or from the escape of fuel gas or oil and the possibility of injury to persons or damage to the containing building.

Provisions should be made for safe removal of overheated products from the building.

Self-contained driers and related equipment, including fuel lines and fuel storage should be located with due regard to the possibility of fire resulting from overheating or from the escape of fuel gas or oil and the possibility of injury to persons or damage to adjacent buildings or structures. Driers should be separated from other structures, including other driers, by approved fire walls without openings, other than openings for spouts or conveyors, or separated by clear space as follows:

(a) By 5 feet of clear space where exposed structures have masonry walls with openings, provided such openings are protected by approved fire doors.

(b) By 10 feet of clear space where exposed structures have masonry walls with unprotected openings, or are of noncombustible construction.

(c) By 15 feet of clear space where exposed structures are of frame, frame ironclad or other types of combustible construction.

A508. Fire Extinguishing Equipment

Fixed Installation. Driers should be provided with permanently installed means of extinguishing fires within drier enclosures. The nature and extent of the protection required will depend upon the construction and arrangements of the drier and, its enclosing structure, if any, and the product being processed.

It is recommended that one of the following means be employed for applying water on a fire within the drying enclosure. They are listed in order of their value.

(1) Fixed water spray devices or sprinklers supplied by an adequate source. (See NFPA No. 15, *Water Spray Fixed Systems for Fire Protection*, and NFPA No. 13, *Standard for the Installation of Sprinkler Systems.*)

(2) One- and one-half-inch hose of sufficient length to reach all access openings on the drier, supplied by a 2-inch or larger water pipe, and adequate source. (See NFPA No. 14, *Standard for the Installation of Standpipe and Hose Systems.*)

(3) Small diameter hose of sufficient length supplied from domestic source, when more adequate supply is not available.

Note: Direct-fired rotary driers which may be damaged internally by application of water should be provided with ports or other means which will permit the injection of carbon dioxide or stream.

Portable Fire Appliances. One or more portable extinguishers approved for use on Class A fires should be provided for use within or in the vicinity of the drier enclosure, and one or more approved extinguishers having a rating of 8-B:C or better shall be provided for electrical fires. (See NFPA No. 10, *Standard for the Installation of Portable Fire Extinguishers.*)

A702. Removal of Static Dust. Push brooms of hair or soft fiber should be used as they will throw less dust into suspension than ordinary brooms, and are better adapted to sweeping under belts and other machinery.

A7021. Vacuum Sweeping Apparatus. Installation of approved permanent, semipermanent portable vacuum cleaning systems should be provided for removal and collection of normal static dust deposits.

When floor sweeps are provided, air velocity through such floor sweeps shall be sufficient to pick up and carry such dust deposits including incidental kernels of whole grain which may be present.

A901. Fire Protection

Automatic Sprinklers. An approved system of automatic sprinklers should be provided for the protection of all areas containing combustible materials (other than grain). For grain risks located in areas with inadequate water supplies for a standard system of automatic sprinklers, the installation of sprinklers in elevator cupolas and other areas containing combustible materials supplied by a dry standpipe with outside fire department connection should be provided.

Supervisory Services. For prompt detection of fires, either a watchman, an automatic fire detection system or sprinkler water flow and supervisory system should be provided. If guard service is provided, routing, the recording apparatus, etc., should be as recommended in NFPA No. 601, *Recommendations for Guard Service*

in Fire Loss Prevention. Automatic fire detection systems to actuate local alarm or other suitable arrangement for automatically notifying fire department in event of fire should be provided in accordance with the provision of NFPA No. 72A, *Local Protective Signaling Systems* or NFPA No. 72C, *Remote Station Protective Signaling Systems.*

Standpipe and Hose. Standpipe systems should be installed to protect all areas containing combustible materials as provided in NFPA No. 14, *Standpipe and Hose Systems.* One- and one-half-inch hose and combination fog and straight stream nozzles should be used.

Hydrants. Either public or private fire hydrants supplied by adequate water system should be provided for fire fighting use.

Explosion Suppression. Approved explosion protection systems designed for instantaneous detection and suppression of impending explosions are available for use in confined areas such as bins, tanks, dust collectors, etc. Use of such devices should be considered in unusually hazardous areas where other means of hazard control are not suitable. Such devices should be in accordance with NFPA No. 69, *Explosion Prevention Systems.*

Fire Fighting Operations. Fire Department or hose streams should be used with great care in grain elevators and other grain handling risks, as hose streams carelessly used may disperse static dust, cause structural damage to bins, or lead to quality deterioration of grain.

A1003. Fumigation. Because of toxicity and possible fire hazard, fumigants should be stored in a detached building used for no other purpose.

A1007. Miscellaneous Storage. There should be no storage of sacks, sacked grain, screenings, combustible merchandise, materials, unused machinery, parts and supplies within handling and grain storage buildings.

A1012. Outside Grain Storage. Care should be exercised in selection of outside bulk storage areas to avoid exposure from adjoining structures.

Tarpaulins used for covering grain should be flame-resistant treated. Plastic sheeting used for the purpose should be of slow-burning or self-extinguishing type.

A1013. Shovels. Hand shovels used in shoveling of grain, dust and other refuse on concrete or steel bin bottoms, floors, etc., should be made of nonsparking materials.

A1014. Grain Temperature Indicators. An approved installation of grain temperature indicators should be installed in all grain storage facilities. The number and location of detectors should be in accordance with manufacturers' specifications. Control and recording equipment shall be installed in accordance with NFPA No. 70, *National Electrical Code*.

A1015. Internal Combustion Engines. Grain handling equipment using internal combustion engines, except those labeled for Class II, Division 1, Hazardous Locations, should not be used inside any grain handling or storage plant.